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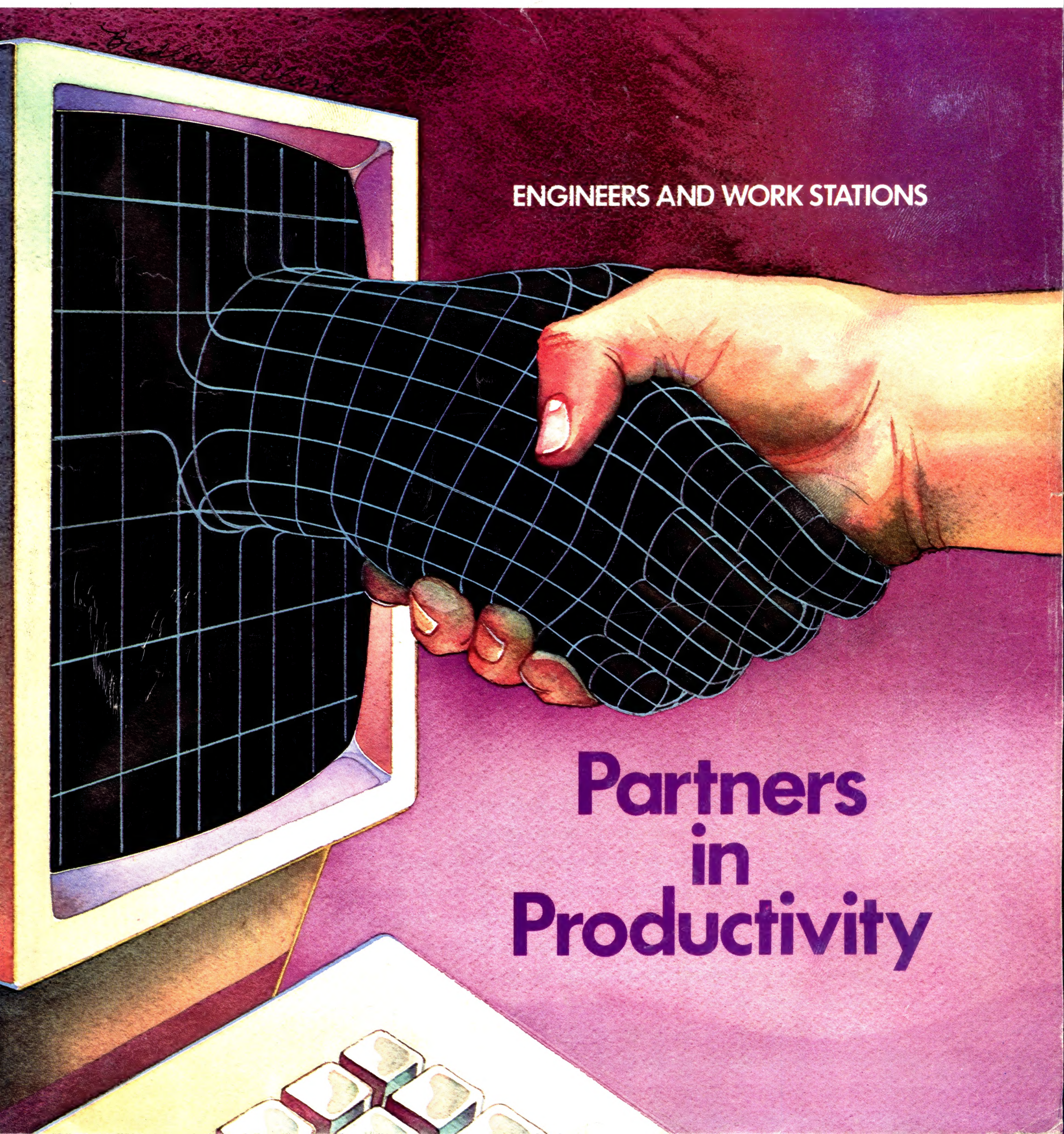

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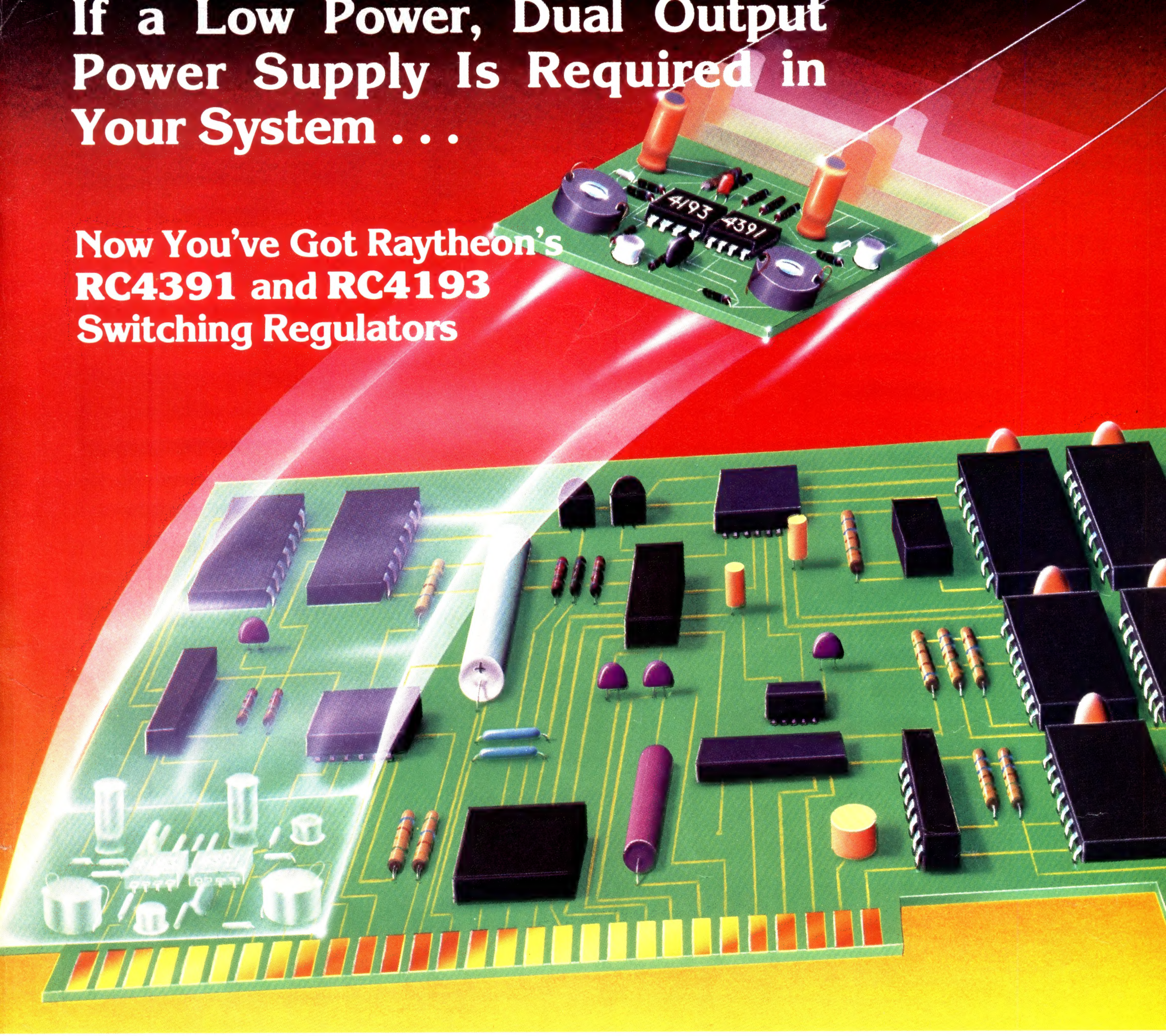

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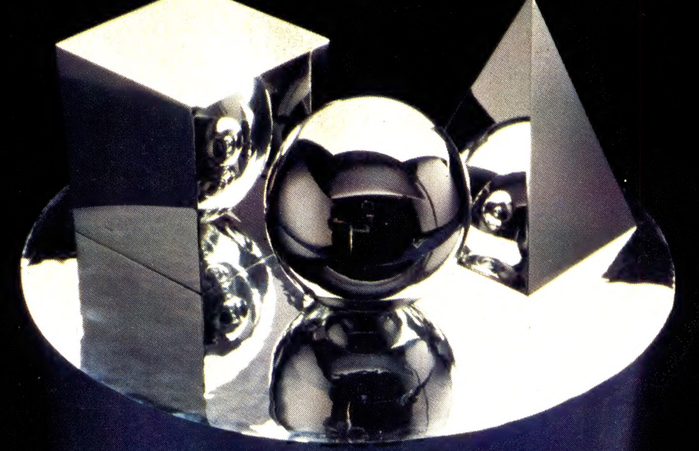

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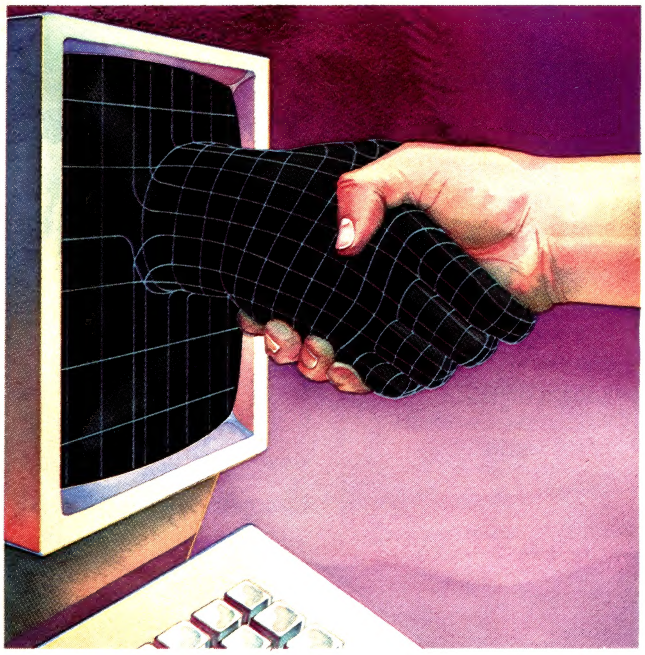

The Cover Story

Engineers and work stations: partners in productivity

Relatively inexpensive *yet powerful microprocessors and memory chips have made engineering work stations a reality.*

They are crucial *to the continued development of ever-more-complex circuits, given the shorter design cycles required in today's volatile markets.*

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People craving instant access to information stored in very large data bases may soon find fulfillment thanks to powerful personal computers, networks of large computers, and links between personal computers and mainframes. Future data-base systems may well have expert aids for system and application design and perhaps even the software to handle it.

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In applications below 100 kilohertz, signal analyzers combining fast Fourier transforms with digital signal-processing methods are an effective alternative to swept-generator analyzers. This new tool helps designers collect and display up to 60 separate spectra in less than 10 seconds. Engineers can now tune circuits or components with a frequency spacing of 1 hertz or less and watch the changing response in real time.

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Smart power devices: A staff-written analysis reviewing the recent developments and future trends in smart-power technology will also discuss the strategies of a number of major manufacturers of these devices and identify some applications. . . . **May 31.**

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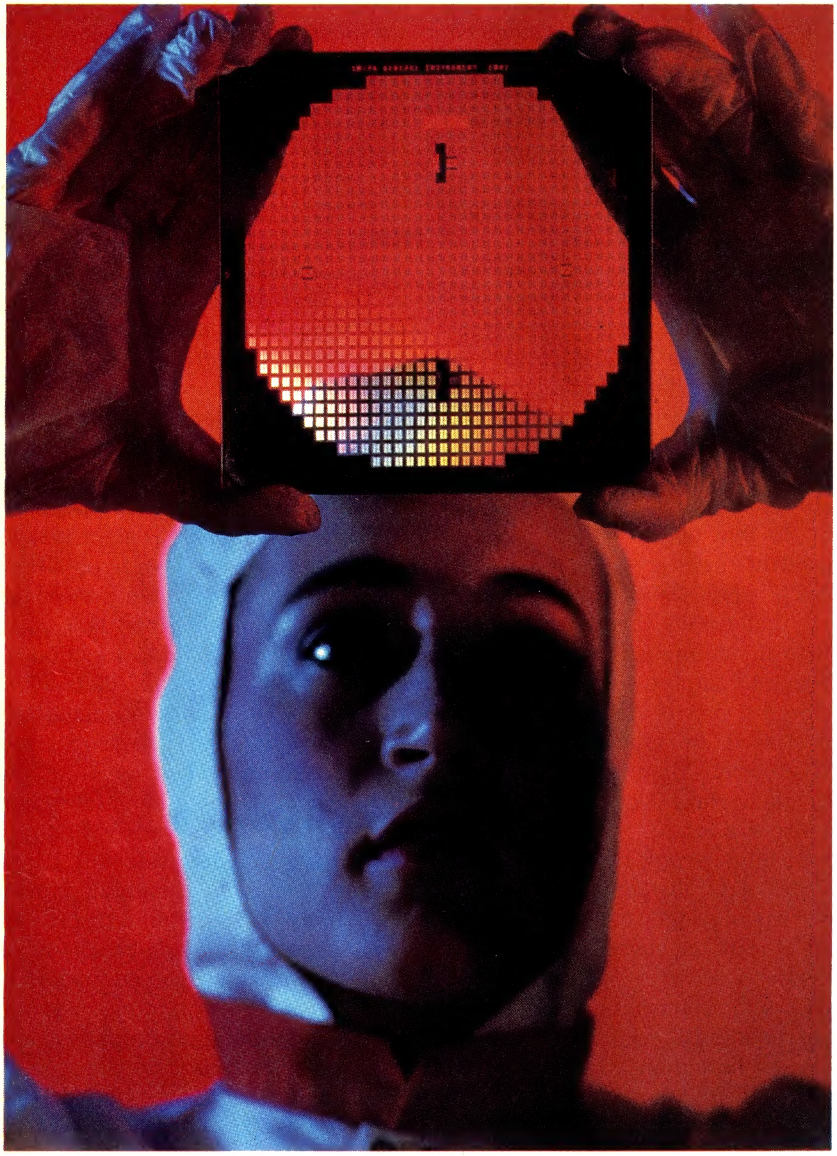

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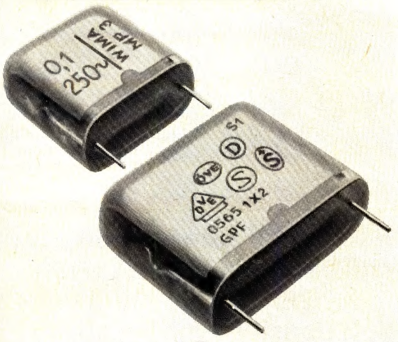

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Editor's letter

Our industry has by now advanced into a realm that once belonged solely to science fiction, for today's engineers are using the industry's best machines to build even better ones. Work stations for electronics-engineering design have become a reality thanks to the coming of powerful and cheap microprocessor and memory chips. The ultimate payoff from today's design-engineering work stations can only be imagined, but tomorrow's engineers will certainly spend less time on repetitive, time-intensive, and routine tasks and more time on creative designing.

Both on general-purpose and application-specific integrated circuits and circuit boards, today's crop of microprocessor-based work stations can handle much of the detailed work of design and engineering. These silent, faithful, attentive servants are providing stand-alone processing power for smaller engineering groups and even for individual engineers. Though expensive, the cost of these work stations is reasonable relative to that of the skilled engineering talent they serve.

Such work stations and the software that makes them tick are crucial to the continued development of evermore complex circuits—especially for the shorter design cycles that are needed in today's competitive marketplace. Manufacturers of design-engineering work stations will vie for a business that could reach the $1 billion mark by the end of the decade. And like any true innovation, engineering work stations provide benefits for buyers as well as for sellers.

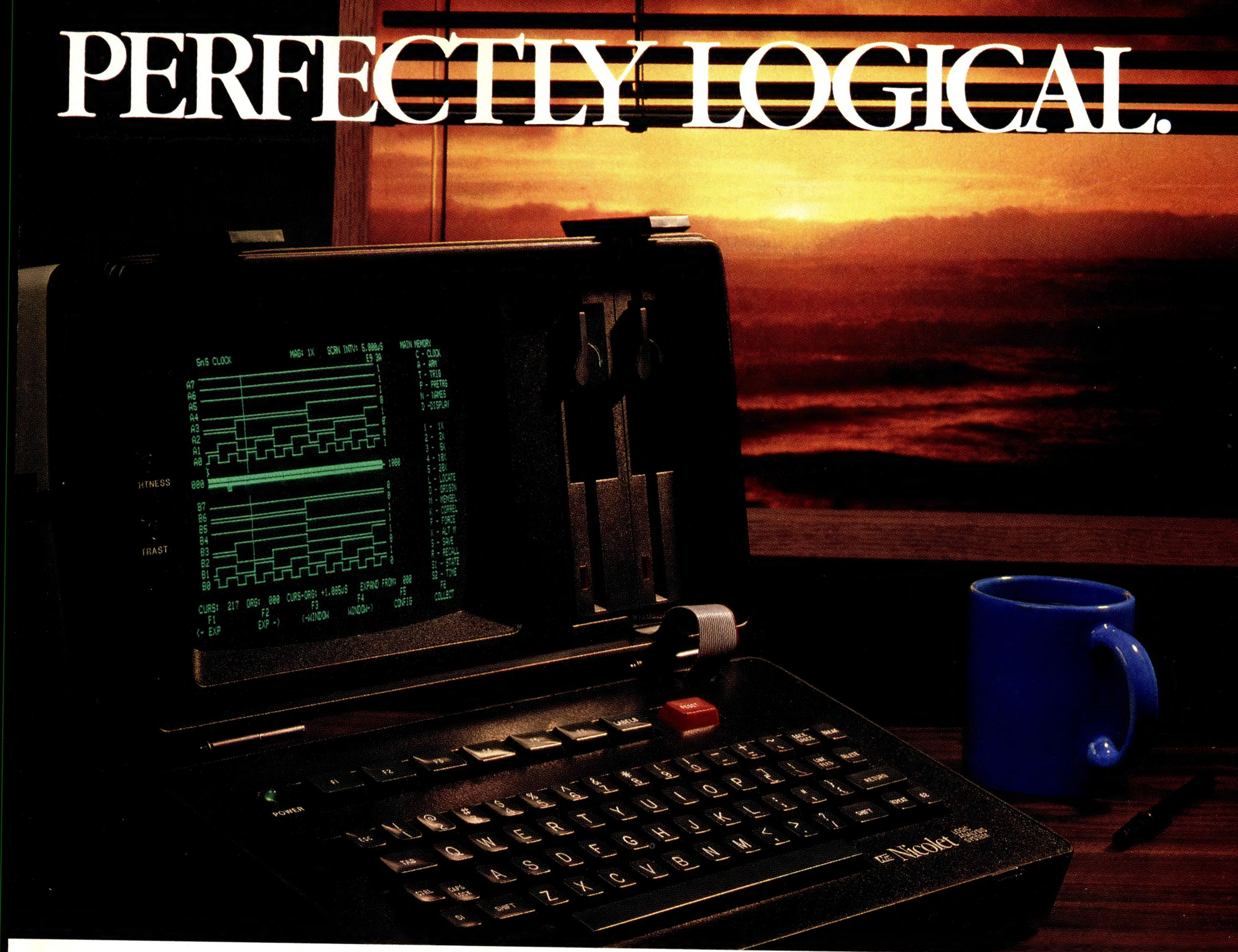
We sent contributing editor Stephen Evanczuk, who is well versed in the work-station arena, to investigate the field, as did several of our bureau editors. They found that it is very active indeed. In fact, Steve and his team came up with so much valuable and interesting material that selecting, condensing, and presenting the most important information turned out to be a monumental job. Backed by a multitude of personal interviews and reams of research, Steve worked through many long evenings to hone the article for the pages of *Electronics.* The team's many surprising discoveries about engineering work stations and their market are uncovered in our cover story, beginning on page 121.

All of us who work in offices—engineers or no—could use an up-to-date electronic personal assistant: a work station to store and manage information to help us raise our personal productivity. Engineers can have these personal-productivity tools added to their engineering work stations. For the rest of the office-based (or office-bound) workforce, the electronic assistant is called a personal computer. In essence, all personal-computing functions hang on the storage, management, and retrieval of information, so it is not surprising that data-base systems have at last begun to play a major role in personal computing.

The latest personal computers are smart enough to handle sophisticated data-base systems, inexpensive enough to be used by office workers, and powerful enough to store tons of information. As a result, data-base systems are now coming into the limelight by making personal computers simple enough to function as everybody's personal assistants.

Our special report on data-base systems, beginning on page 131, was researched and written by Tom Manuel, senior editor for information systems, with help from a first-rate team that included software editor Jeremy Young and Frankfurt bureau chief John Gosch. Tom's report surveys the world of data-base systems and natural-language interfaces in such areas as mainframe-to-microcomputer links, minicomputers, and personal computers.

Our editorial team found that data-base systems are taking on an increasingly important role as the heart of integrated applications for personal productivity—not only on personal computers but also on personal computers linked to mainframes and minicomputer systems. Today's data-base machines could launch new architectures and distributed computing applications at affordable prices. ☐



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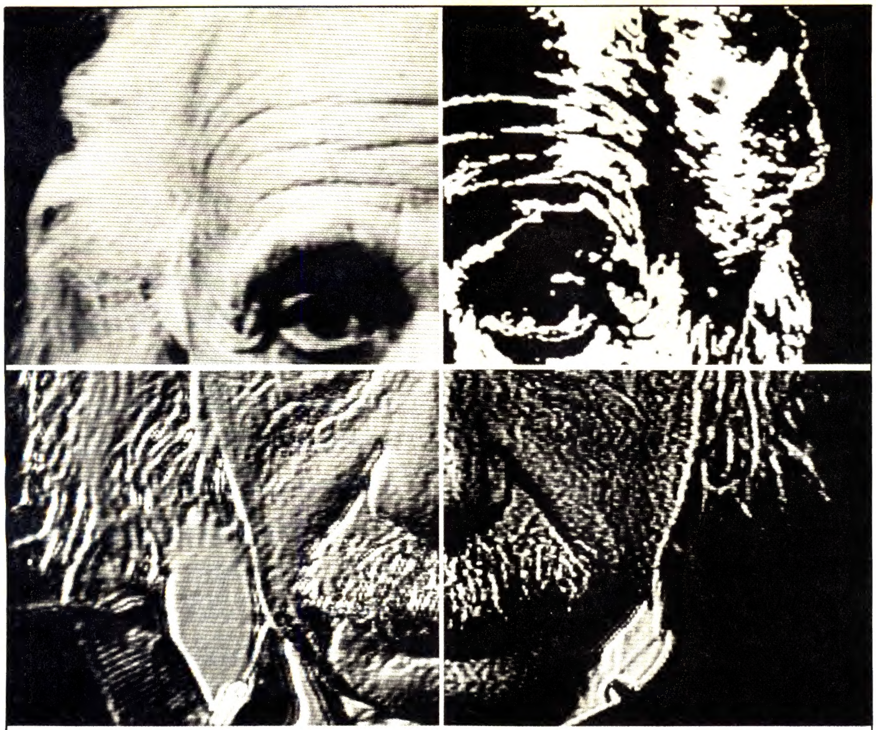

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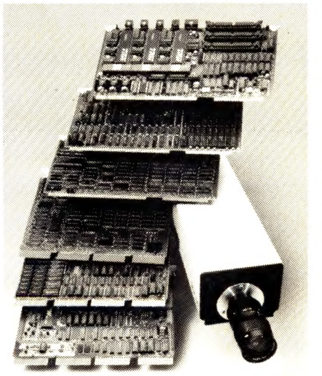


Readers' comments

Over the brink

To the Editor: I appreciate your coverage of my paper at the International Solid State Circuits Conference ("Designers shave memory-cell size as they cut power costs and use new technology to enlist alternate memory organizations," Feb. 23, p. 126). Unfortunately, a misprint took my design from the leading edge of semiconductor technology and moved it over the brink of believability.

The 1-million-cycle erasable programmable read-only memory with on-chip error checking and correction circuitry I described is a 64-K, not 256-K, part, as your article reported. I hope this letter clears up any misunderstanding.

Sanjay Mehrotra
Seeq Technology Inc.
San Jose, Calif.

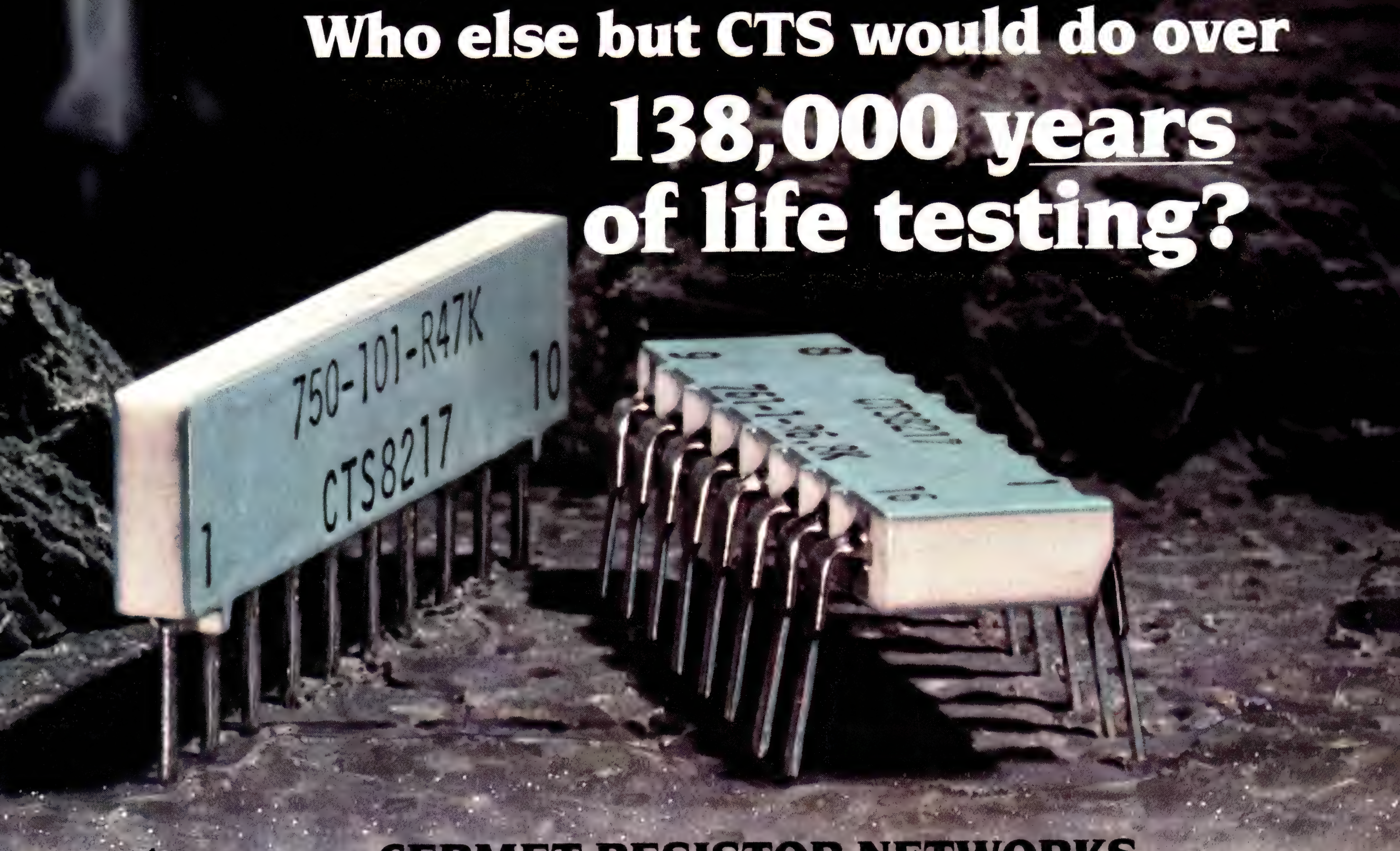
Raising standards

To the Editor: Some years ago, the term "blivet" was used to denote 5 pounds of a substance squeezed into a 2-lb. bag. This term came to my mind when I read your editorial "Improving the engineer's image" (Feb. 23, p. 12), in which you advocate adding liberal arts courses to the engineering curriculum. Where will these courses fit, after all? What courses will be removed to make room for these new ones?

Your recommendation is not only desirable but possible, however. What is needed is to recognize that over the years, there has been a great credit-hour inflation. The same courses that once were worth three credits are today awarded five. Moreover, degree credits are now awarded for courses that can only be described as remedial.

Adding liberal arts (particularly English) courses and squeezing the water from credit-inflated courses will doubtless mean that the engineering curriculum will be more difficult. Thus, expect opposition from the professors, who will quickly understand that raising the standard will mean fewer students.

Irwin Feerst
Committee of Concerned EEs
Massapequa Park, N. Y.



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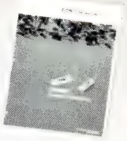

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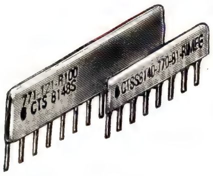

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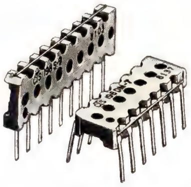

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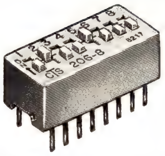

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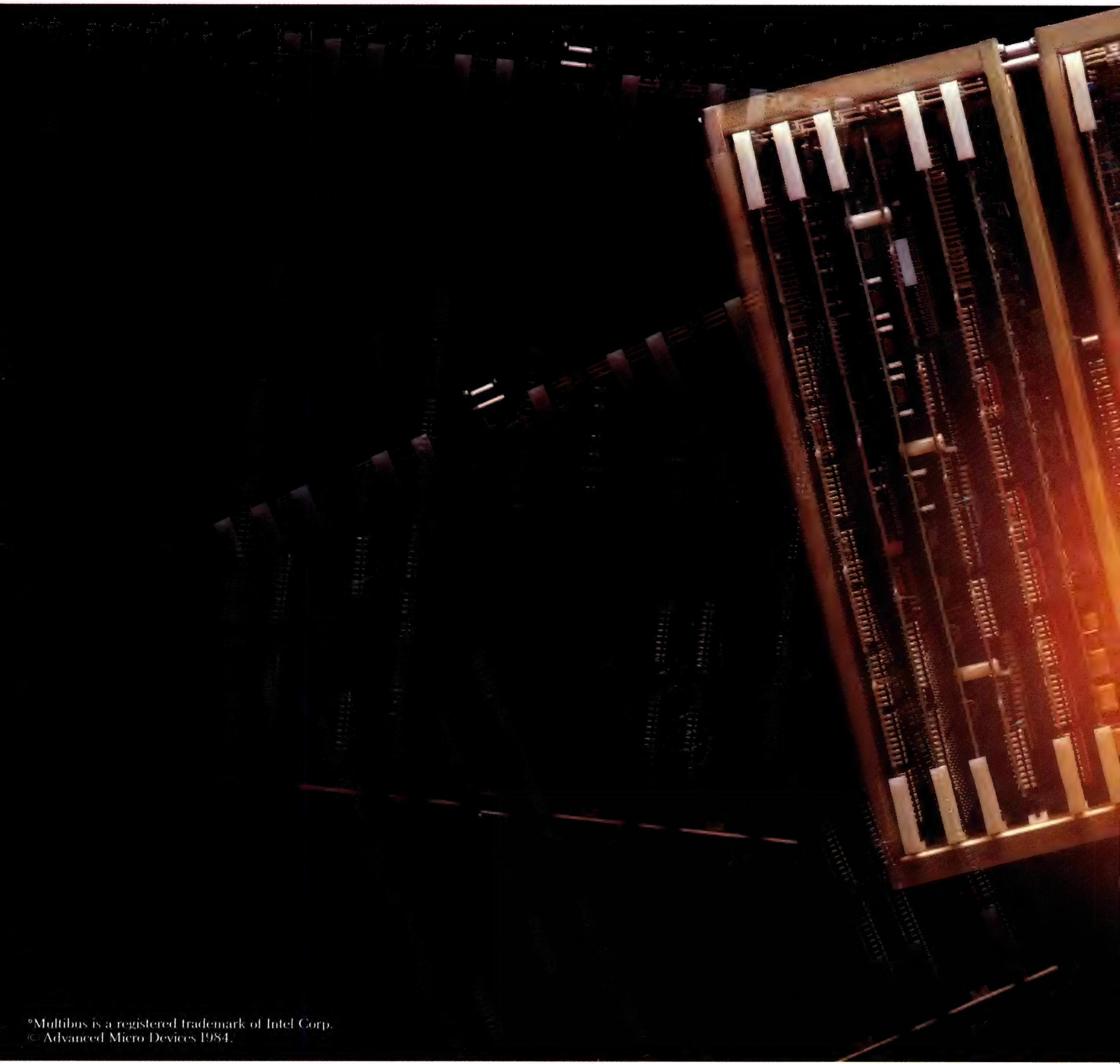

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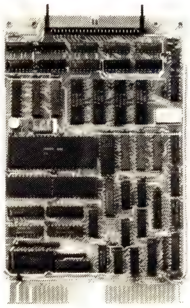

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News update

The race to establish a high-performance standard for 5¼-inch Winchester-disk interfaces is far from over, but the Enhanced Small Disk Interface (ESDI), promoted by the Maxtor Corp. of San Jose, Calif., seems to be showing the early foot.

Last year, a large manufacturer of controllers, Xebec, of Sunnyvale, Calif., and a large maker of disks, Priam Corp., of San Jose, tried to rally support for the American National Standards Institute BSR X3.101 interface [*Electronics,* Aug. 25, 1983, p. 119]. A month later, Seagate Technology, of Scotts Valley, Calif., weighed in with its own interface, the ST412HP. The ESDI and ANSI standards called for data separation to be performed on the drive, but Seagate kept that operation on the controller. All three standards are rated at 10 megabits per second.

So far, all these interfaces have been mere promises. But by the time of the National Computer Conference, this summer, ESDI equipment will be available from five drive manufacturers and half a dozen controller firms, says Skip Kilsdonk, Maxtor's marketing director. One of these firms will be Xebec.

Kilsdonk says Xebec's move means that ESDI is home free. "The largest controller manufacturer and the largest drive manufacturer have announced product support for it," he points out. Among drive makers, Fujitsu, Micropolis, and Memorex (as well as Maxtor) will have ESDI products. As for controller makers, Emulex, Xylogics, Interphase, Omti, Data Technology Corp. (as well as Xebec) will have them. Priam says it will build an ANSI drive for a customer but will support any interface that has market acceptance.

Seagate will introduce its ST412HP interface on an 8- rather than 5¼-in. drive. Only Vertex Peripherals has announced a small disk with the Seagate interface. "ESDI drives will have started shipping before ours," says Seagate's controller product manager, Don Nanneman. "We are a volume manufacturer; we won't necessarily want to be first, only to be there when the market demand is there." **–Clifford Barney**

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People

More automation of production is goal for Apple's Barron

Westerners in their right minds would not climb into a ring with a Sumo wrestler. But U. S. production engineers are mounting a challenge in another arena where the Japanese dominate—integrated manufacturing.

Machines from machines. Peter J. Barron supervises highly automated Macintosh production.

In the vanguard is Apple Computer Inc., producer of the fast-selling Macintosh personal computer [*Electronics,* Jan. 26, p. 87]. At the company's plant in Fremont, Calif., 200 persons working in two shifts on a highly automated assembly line turn out some 1,600 Macintosh machines a day. "We started last November, and we'll be ramped up to 2,000 a day by June," says Peter J. Barron, operations manager for the Macintosh division.

Fremont is a "focus factory," he says—a step toward even higher automation in later plants. "Materials handling is the big problem in an automated factory," according to Barron. "An essential concept is on-time delivery of parts by suppliers, the way the Japanese do. Most of our suppliers schedule shipments for a window of two to three days. There is practically no inventory and very limited incoming inspection."

At Fremont, printed-circuit boards are stuffed in an automated line. On each board, Japanese robots do the half-dozen connectors that cannot be handled by insertion heads. "For our next factory, I hope we can have only American robots, but I'm not sure," Barron says.

He was a veteran in high-volume consumer-electronics production when he joined Apple last summer. The 41-year-old metallurgy graduate of the University of Nottingham, in England, came from Texas Instruments Inc., where he was vice president of the consumer-electronics operation, in Lubbock. While he was there, TI increased production of its 99/4A home computer from 10,000 to 300,000 a month in just nine months.

Still, Barron knew he was taking a big risk setting up the Fremont integrated factory. "I told Steve Jobs [an Apple founder and now chairman] that it was insane to build a new machine in a new factory," he recalls. But Macintosh is a heavy seller and Barron now feels confident about getting yields to the level the factory was designed for—95% on the first pass.

Palmer vows to continue diversification of Mostek

Many U. S. memory makers would like to forget 1981—the year prices for dynamic random-access memories plunged, taking profits with them. But for Mostek Corp., that year and the tough months following spurred "the most ambitious diversification effort in the entire electronics industry," says Robert B. Palmer, the company's recently named executive vice president and head of the new Semiconductor Operation in Carrollton, Texas.

The 43-year-old native of Stephenville, Texas, has played an important role in that effort. After record 1980 profits in 16-K RAMs, Mostek lost millions of dollars for each month in 1981 and much of 1982, when RAM prices collapsed. Parent United Technologies Corp. appointed Harold L. Ergott Jr. as president of Mostek, and a diversification program was quickly set in motion to change the

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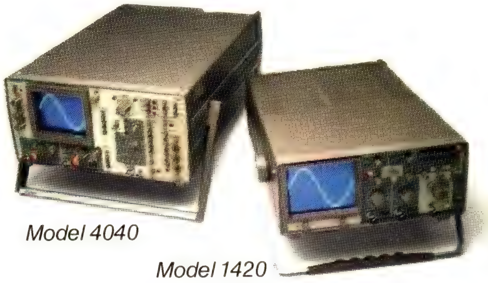

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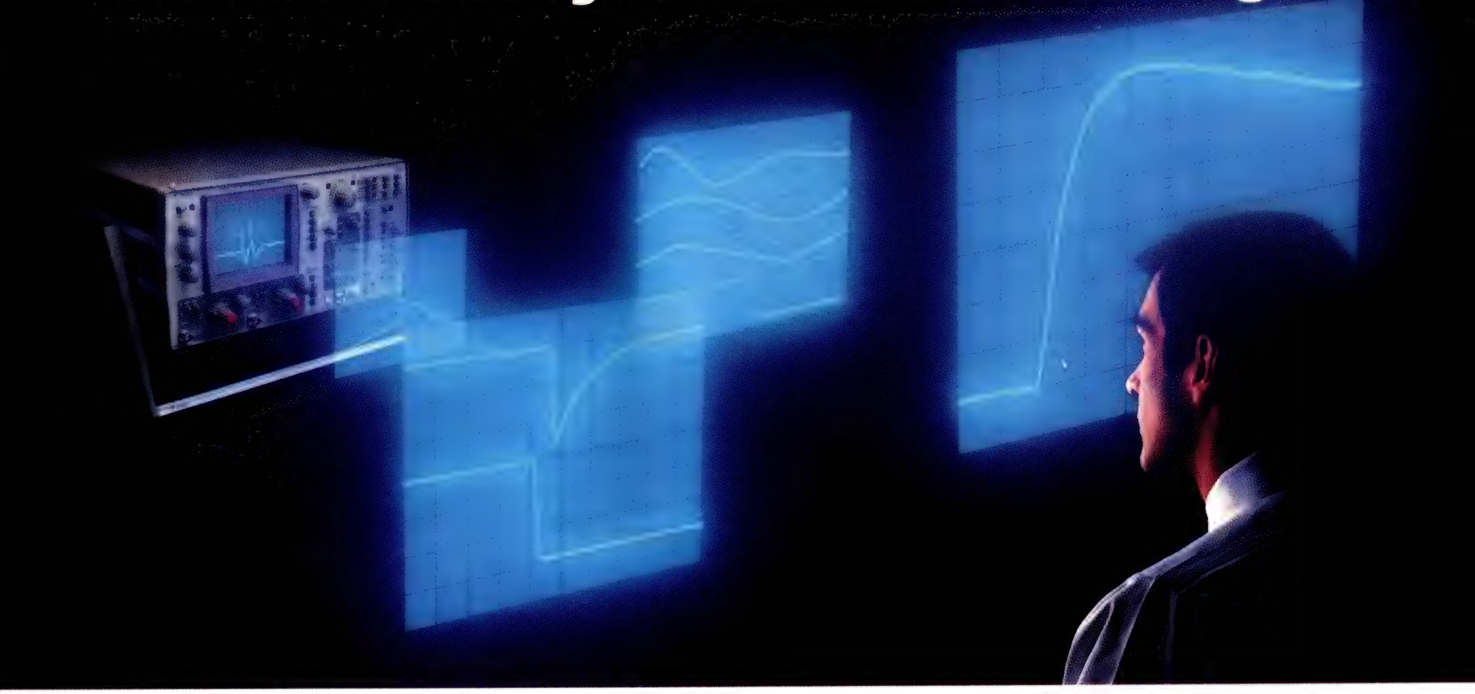

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People

Changes to continue. Robert B. Palmer says Mostek will be a changed company.

firm's precarious position in the dynamic-RAM business.

Now that the economy has recovered, Mostek—like other memory makers—enjoys hefty profits in 64-K dynamic RAMs. But Palmer, one of those who founded Mostek back in 1969, knows that now is not the time to delay diversification. When the next turndown begins, Mostek hopes to be a changed company.

The thrust will mainly benefit two divisions created last April in the Semiconductor Operation. Palmer says that the Storage & Advanced Products division will redirect Mostek's memory-chip emphasis from commodity dynamic RAMs to high-performance and special products.

Even in dynamic-RAM markets, Mostek is bent on diversification. No longer will the firm allocate substantial design and production resources to cheap commodity dynamic RAMs, says Palmer, who received his MS in physics from Texas Tech University in 1967 and then started his engineering career at Texas Instruments Inc., in Dallas. Mostek will instead concentrate on fast devices.

Mostek set up its second new division, Diversified Products, to increase the company's presence in the semicustom-, communications-, and military-components areas, as well as in microprocessors. At this time, two thirds of the firm's semiconductor products come from the Storage & Advanced Products division, notes Palmer. "But as you can tell, we intend to change that," he promises. ☐

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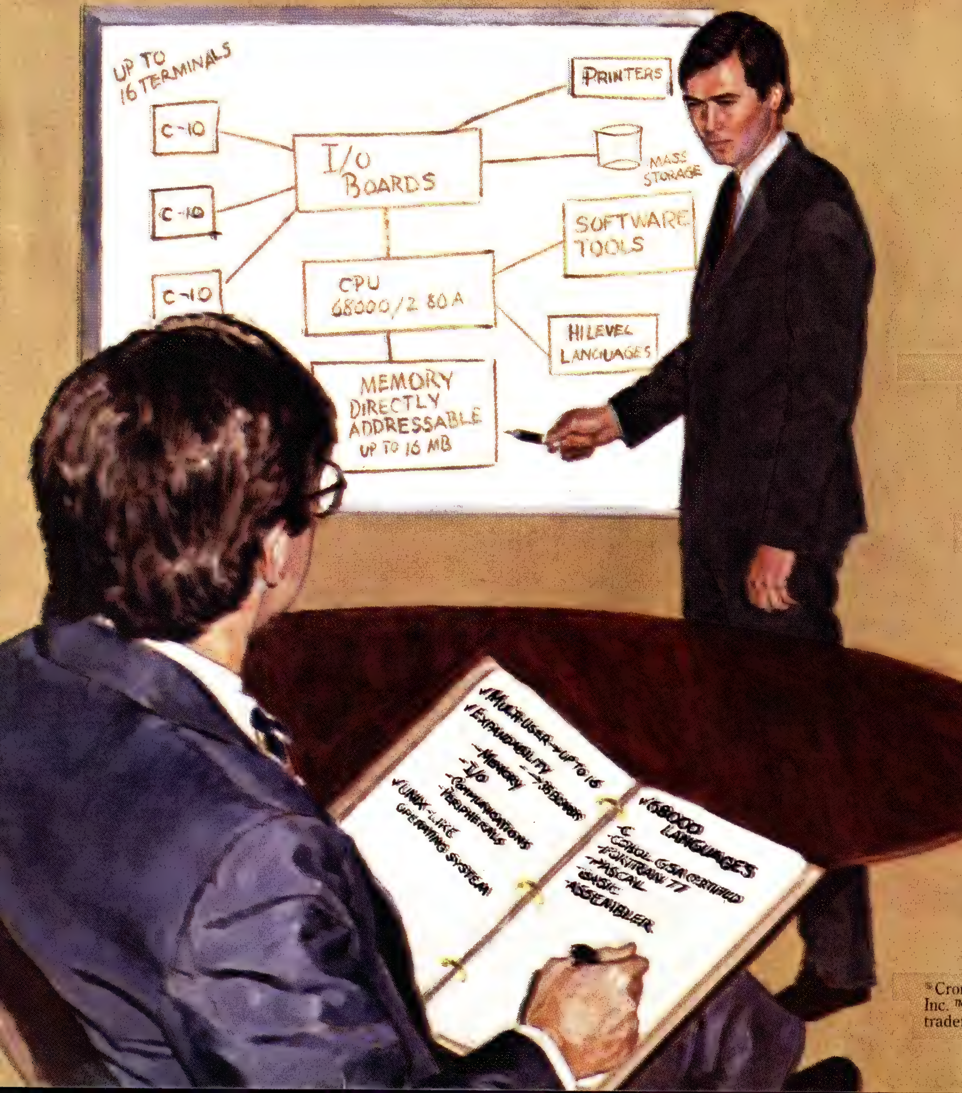

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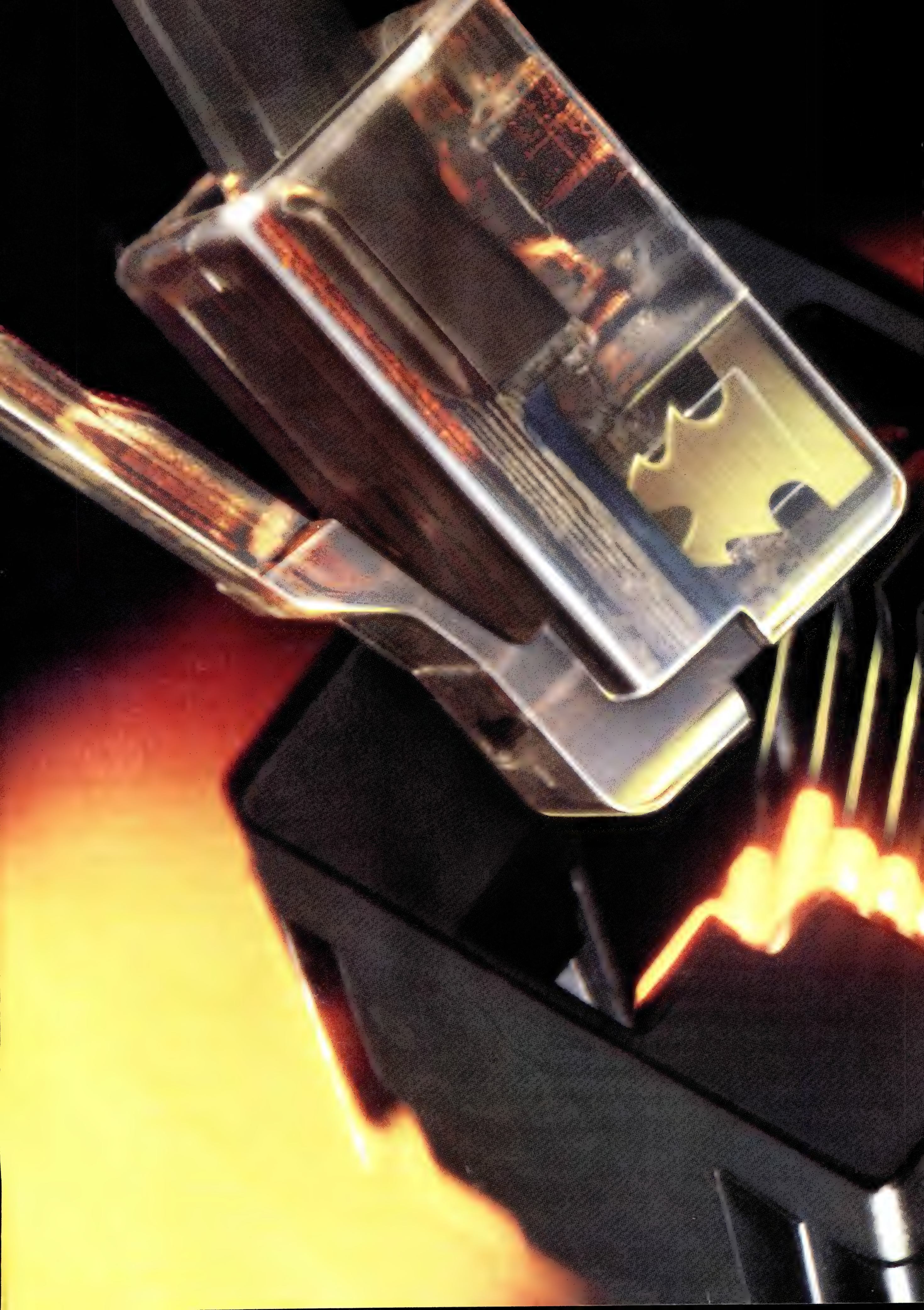

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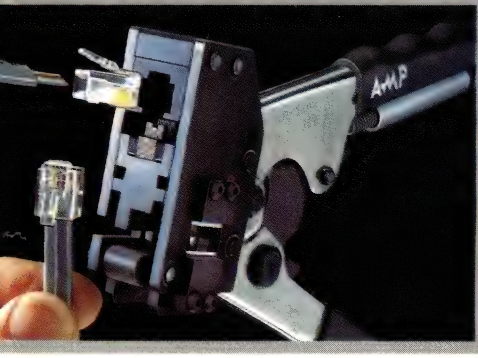

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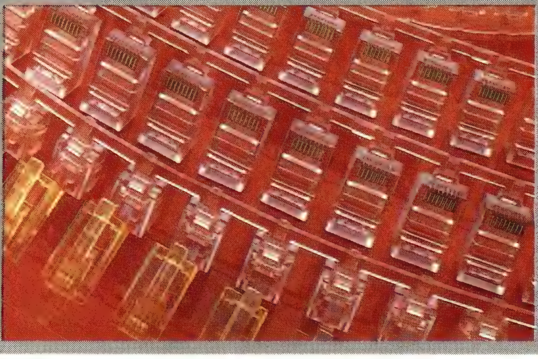

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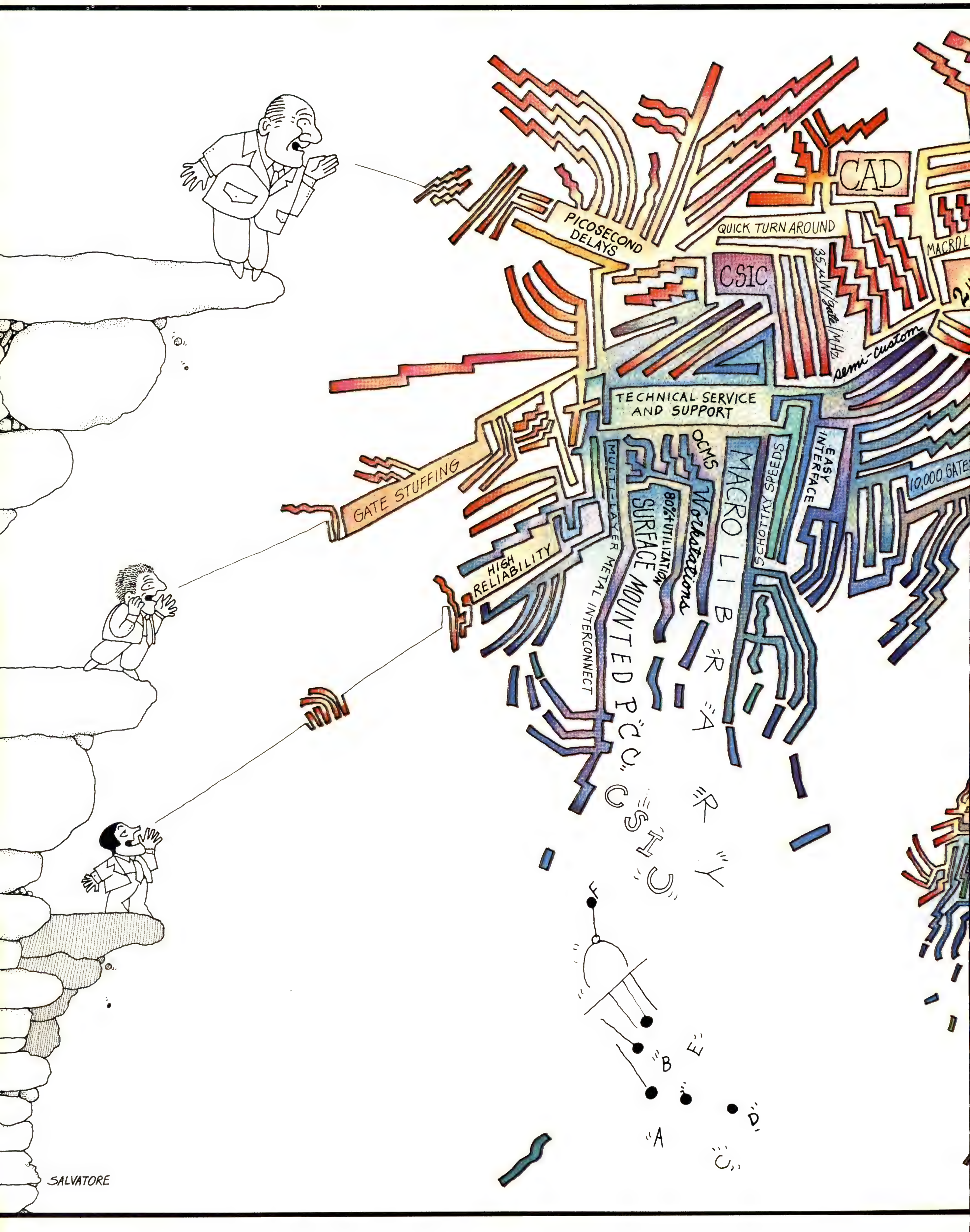
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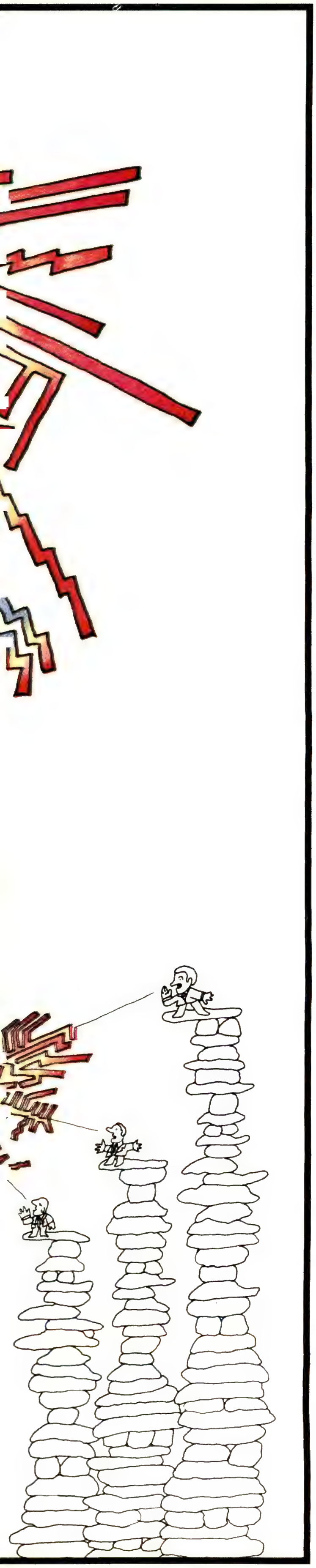

Everybody talks CMOS gate arrays.

But only National goes beyond talk to bring you low power, one nanosecond gate arrays in production quantities.

You know how it is.

Everybody's *heard* about the benefits of CMOS: High density gate arrays with Schottky speeds. Low CMOS power levels with latch-up immunity and ESD protection. All in production quantities.

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We're doing it.

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TEK PROGRAMMABLE INSTRUMENTS

THE ANSWER BY ANY MEASURE

Tektronix automated audio test systems: built to test the best.

Tek's new SG5010/AA5001 Programmable Audio Oscillator and Distortion Analyzer System lets you test the finest professional audio and communications equipment, with uncompromisingly high-quality measurements.

Finally, you can count on computer-controlled audio test equipment that's better than the products you're testing. Coupled with an IEEE-488 controller, the SG5010/AA5001 completes most audio tests quickly, automatically, even unattended.

The new Tek system features extremely low residual noise (less than 3 microvolts) and low distortion (typically 0.0012% at midband when using the audio bandpass filter). It allows you to make all standard audio tests—including THD, IMD (SMPTE, DIN, CCIF difference tone), gain/loss, and signal-to-noise ratio.

Perform most audio production tests up to ten times faster than manually. Tek's Programmable Audio Test System will help your technicians achieve both faster throughput and more comprehensive testing. And because one Tek automated system can do the work of five to ten fully equipped benches, your investment will pay for itself several times over.

Eliminate most slow, repetitive performance testing involved in audio design. Use the new Tek test system to automate measurements, then display the results via graphics for quickest interpretation. Free up design engineers for more creative tasks.

Detect broadcast signal degradation promptly, before equipment failure. The Tek audio test system can help cut downtime by accurately measuring and documenting increases in noise or distortion, or other trends affecting signal quality. Thorough audio proof reports can be generated automatically, every day if desired.

Test with the best. Highly accurate results, made quickly and automatically, add up to savings in the audio field. Even if you're not ready for full automation, Tek also makes the fastest, easiest-to-use manual audio test equipment. Our AA501/SG505 package offers performance equivalent to our new programmable system.

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Japan's threatened raid on software

Make no mistake about it: Japan's Ministry of International Trade and Industry is trying to get something for nothing. In massing its not inconsiderable muscle behind a campaign to push through the Diet, or parliament, its version of a law governing software protection, MITI is trying to do no less than change the traditional concept of software as intellectual property to one that would treat it as industrial property. The Japanese have made no bones about their intention to gain domination of the worldwide computer market, and the proposed law would strengthen their hand in an area where they have traditionally been weak.

The measure's major thrust is to require sublicensing and remarketing of proprietary software coming into the country from abroad. Thus it would be legal under certain conditions for Japanese companies to copy and then license or sell software without permission from the original developer. Furthermore, program code would have to be fully disclosed at the time the software is introduced to the Japanese market. Also, software copyrights would expire after only 15 years rather than the 50 to 75 years commonly provided in other countries.

Companies and Government officials in the U. S. are understandably working hard to head off MITI. They are getting help from some unexpected sources: Japan's Ministry of Education and the ruling Liberal Democratic Party. The education people have drafted their own software bill, which offers protection under a more conventional copyright-law procedure, and refuse to change their stance, meaning that MITI would have to work out a compromise before any bill could be sent to the Diet. And the Liberal Democrats, reacting to strong pressure from Washington, are following a general trade policy of accommodation that is designed to ease tensions, a policy they think the MITI bill would set back. They hope to force MITI to retreat if it cannot offer strong arguments to back its position.

An attempt to come up with such arguments—indeed, a possible turning point in the whole process—could occur the day after the World Computing Services Industry Congress, to be held in Tokyo June 11–13. MITI and its ally, the Japan Software Industry Association, are organizing a major debate on software protection for June 14 in an effort to build support for their software-as-industrial-property position.

Until then, the U.S.–Japan high-tech working committee, which has been trying to arrive at a compromise, will be preparing for its next meeting, in Hawaii in August. But no matter what happens in Tokyo or Hawaii, U. S. companies must keep an eagle eye on the matter because, as one U. S. Embassy official in Tokyo puts it, "MITI is going to try to build up support for its case and try to sell its concept to them [the Liberal Democrats] again later this year." The Japanese have proven formidable enough in open competition; they must not gain a strong software position free of charge.

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Good news travels fast. And the news is EECO has added six new innovative switches to the broadest line of quality thumbwheels anywhere. And on-time delivery of the entire line is assured through our international sales network.

New Miniature Safety-Lock Pushwheels Our new Pushwheel switches are designed with fold-away and pen-set actuators that ensure the security of entered data. These foolproof switches, also in standard thumbwheel and pushwheel versions, come in a range of sizes to meet the most limiting dimensional requirements.

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The Reliable Standards 1776/1976 Since introducing the 1776/1976 in 1978, these thumbwheel switches have established themselves industry-wide as a standard of reliability and excellence. Made to last, offered with a wide choice of options, and affordable—these switches are EECO's tried-and-true performers. And still revolutionary.

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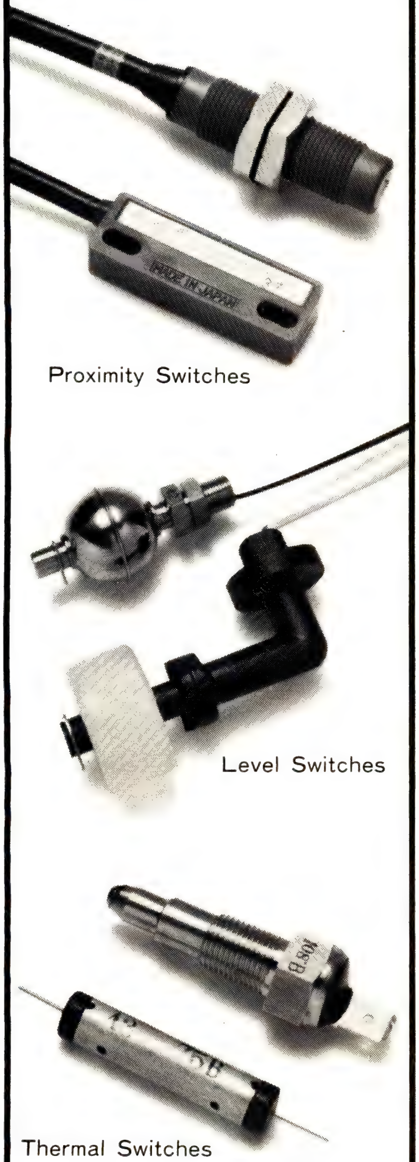
SENSORS



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Meetings

Ohmcon/84, IEEE (Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045), Franklin County Veterans Memorial Auditorium, Columbus, Ohio, June 12–14.

Info/Software, Information Management Exposition & Conference for Software, Banner & Greif Ltd. (Clapp & Poliak, 708 Third Ave., New York, N. Y. 10017), McCormick Pl., Chicago, Ill., June 12–14.

Advanced Manufacturing Systems Exposition & Conference, Banner & Greif Ltd. (AMS 84, 708 Third Ave., New York, N. Y. 10017), McCormick Pl., Chicago, Ill., June 12–14.

Summer 1984 Usenix Conference, Usenix Association & Software Tools Users Group Inc. (Usenix Conference Office, P. O. Box 385, Sunset Beach, Calif. 90742), Hotel Utah, Salt Lake City, June 12–15.

International Computer Show—Cologne (Messe-und Ausstellungs-GmbH, Koln, Messeplatz Postfach 210760, D-5000 Koln 21 [Deutz]), Cologne, West Germany, June 14–17.

42nd Device Research Conference, IEEE (Pallab Chatterjee, Texas Instruments, M/S 369, Box 225621, Dallas, Texas 75265), University of California, Santa Barbara, June 18–20 (coordinated with Electronic Materials Conference, see June 20).

13th International Conference on Quantum Electronics, American Physical Society, Optical Society of America, and IEEE, June 18–21; **Conference on Lasers and Electro-Optics,** IEEE and Optical Society of America, June 19–22 (Optical Society of America, 1816 Jefferson Pl. N. W., Washington, D. C. 20036), Anaheim Convention Center, Anaheim, Calif.

Armed Forces Communications and Electronics Association Conference & Exposition (AFCEA, 5641 Burke Center Parkway, Burke, Virginia 22015), Washington Sheraton Hotel, Washington, D. C., June 19–21.

microCompona, Network Events Ltd. (Network Events Ltd., Printers Mews, Market Hill, Buckingham, MK18 1JX, England), Philips Congress Centrum, Eindoven, The Netherlands, June 19–21.

First International Conference on Computers & Applications, IEEE and Chinese Institute of Electronics (Harry Hayman, IEEE Computer Society, 1109 Spring St., Suite 300, Silver Springs, Md. 20910), Beijing (Peking), China, June 20–22.

26th Electronic Materials Conference, The Metallurgical Society of AIME (420 Commonwealth Dr., Warrendale, Pa. 15086), University of California, Santa Barbara, June 20–22.

IEEE VLSI Multilevel Interconnection (V-MIC) Conference, IEEE (Thomas E. Wade, Microelectronics Research Laboratory, Electrical Engineering Dept., P. O. Drawer EE, Mississippi State, Miss. 39762), Hotel Inter-Continental, New Orleans, La., June 21–22.

Conference on the Forefronts of Large-Scale Computational Problems, American Federation of Information Processing, *et al.* (Hal Raveche, A311 Physics Building, National Bureau of Standards, Washington, D. C. 20234), Gaithersburg, Md., June 25–27.

International IEEE/AP–S Symposium and National Radio Science Meeting, IEEE, *et al.* (Harold R. Raemer, AP–S and URSI Symposium, Dept. of Electrical Engineering, Northeastern University, Huntington Ave., Boston, Mass. 02115), Copley Place, Boston, June 25–28.

Seminar

Semiconductor Power Devices, Communications Consulting & Publishing Inc. (Dr. Fadel A. Selim, Westinghouse R&D Center, 1310 Beulah Rd., Pittsburgh, Pa. 15235), Gaithersburg Marriot Hotel, Gaithersburg, Md., June 13–15.

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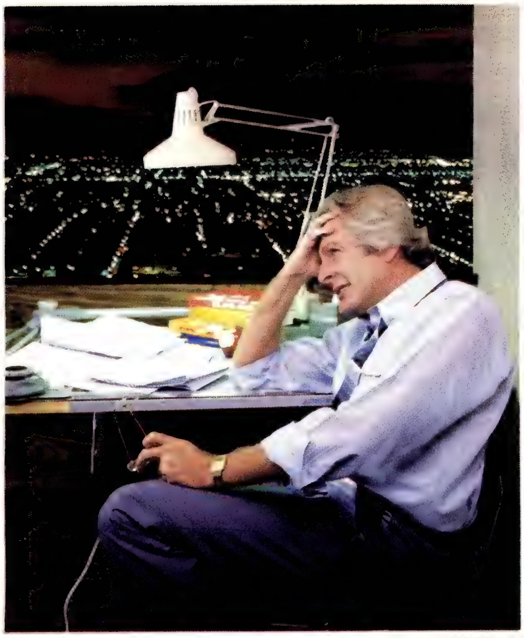
A TALE of TWO CITIES



Sunnyvale, California — 8:30 PM

Boca Raton, Florida — 5:00 PM

How FutureNet's DASH-1™ Has Revolutionized Schematic Design and Documentation!

Increased Schematic Design Efficiency

Obviously the engineer in Boca Raton has a big edge over his counterpart in Sunnyvale. The reason is simple. He uses FutureNet's DASH-1 Schematic Designer to create perfect schematics on his IBM PC... in a fraction of the time it takes others who still struggle with manual methods.

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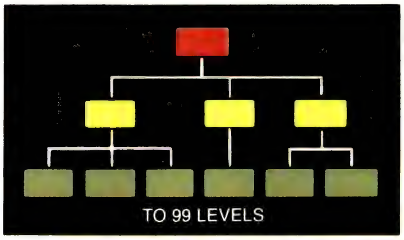

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An exciting new option, STRIDES™ (Structured Interactive Design System), lets you set up a complete "drawing tree" under DASH-1 control. Basically it works like this. When any drawing is updated, all related Pin Lists, Net Lists, Lists of Materials can also be updated automatically, at one time. And with STRIDES incredible power, up to 99 subordinated levels of drawings, net lists, etc., can be related to each other. Previously, if you could even find this capability on another system, it would cost you 10 to 20 times more than DASH-1.

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AT MINI MICRO IN BOSTON"

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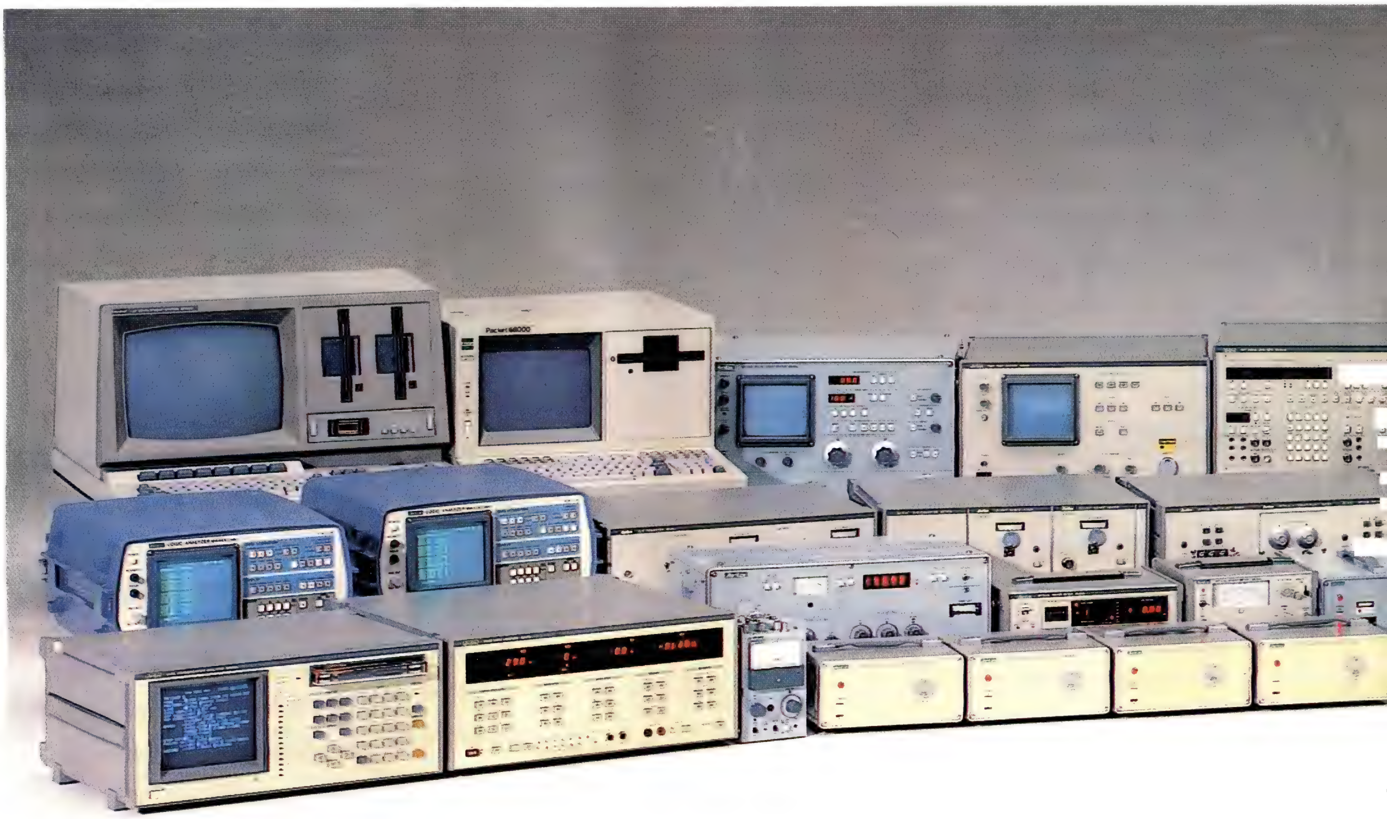
Better Instruments for Better Communications



The MS710A Spectrum Analyzer

Covers 10MHz to 23GHz, with an amplitude range from −115 all the way to +30dBm. Search functions locate the desired signal fast. Internal tracking preselector keeps distortion way down. And easy-to-read CRT display has alphanumeric labels for all important information. Another professional instrument from Anritsu.

Anritsu means communications.

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optical and digital transmission systems, Anritsu communications products are highly regarded for both unequalled reliability and technical excellence.

With such wide-ranging experience in all phases of communications, it's no surprise that our electronic measuring instruments are superior, too.

Anritsu builds the electronic instruments that keep electronic and fiber optic communications operating at the knife edge of efficiency. From the simple measurement of voltage and current to complete high-level analysis of both analog and digital circuitry, Anritsu instruments are built by experts in communications. And Anritsu instruments are built to be used.

Whether it's an Anritsu electronic voltmeter, a network analyzer or a complete GPIB-based automatic test system, you'll find a basic field-proven ruggedness built in. And you'll find controls that actually make sophisticated measurements simpler to perform.

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IF IT WEREN'T FOR UNIX WE NEVER COULD HAVE BUILT THE PYRAMIDS

Ordinary computers, yes. But not a Pyramid Technology 90x.

After all, here's a supermini not just capable of running UNIX,™ but born to run it. And run it up to four times faster than the most popular UNIX host. For a lot less money.

The secrets of this Pyramid are a thorough understanding of UNIX, a few fundamentals of RISC (Reduced Instruction Set Computer) theory, more registers than 30 VAXs, and a 32-bit proprietary architecture that outperforms a roomful of micros.

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For example, gone are 85% of performance-robbing memory references. The endless parameter shuffling of yesterday's technology has been replaced with a hardware register win-

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It's amazing what hardware architects can do, given the chance. It's almost as startling as what our software wizards did.

They crafted OSx, a dual port of Berkeley's 4.2 BSD and Bell's System V. Because you can switch environments at will, no UNIX port offers more capabilities. With absolutely no loss of compatibility.

Well, almost.

We do admit to one feature not compatible with other UNIX systems. Our single-source support.

One telephone number instantly connects you to both hardware and software experts. In-house pros, who spend their energy pointing you towards solutions. Not pointing fingers at each other.

So no matter how you see your requirements shaping up, contact Pyramid Technology, 1295 Charleston Road, Mountain View, California 94043. Or call (415) 965-7200.

Because when it comes to running UNIX, a Pyramid looks good from any angle.

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Neff Series 600 . . .

data acquisition technology just moved ahead 10 years.

Neff's new System 620/Series 600 amplifier-per-channel data acquisition system offers performance you might expect only in systems of the future:

- ***Programmable gain; ranges: ±0.065mV f/s to ±10.24V f/s***
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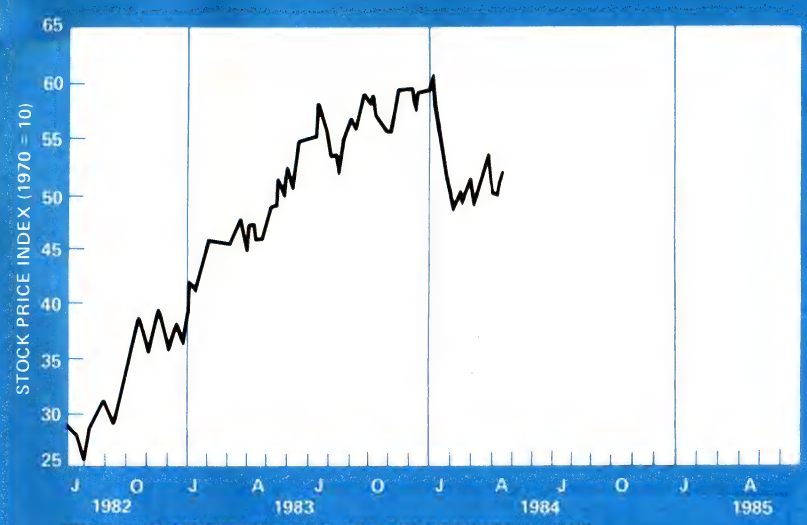
Business activity

"Trends in semiconductor and components stocks" records the stock market activity of a selected group of publicly owned semiconductor and components manufacturers. The index weights the companies by size and therefore reflects their relative performances.



TRENDS IN SEMICONDUCTOR AND COMPONENTS STOCKS

SOURCE STANDARD & POOR'S CORP

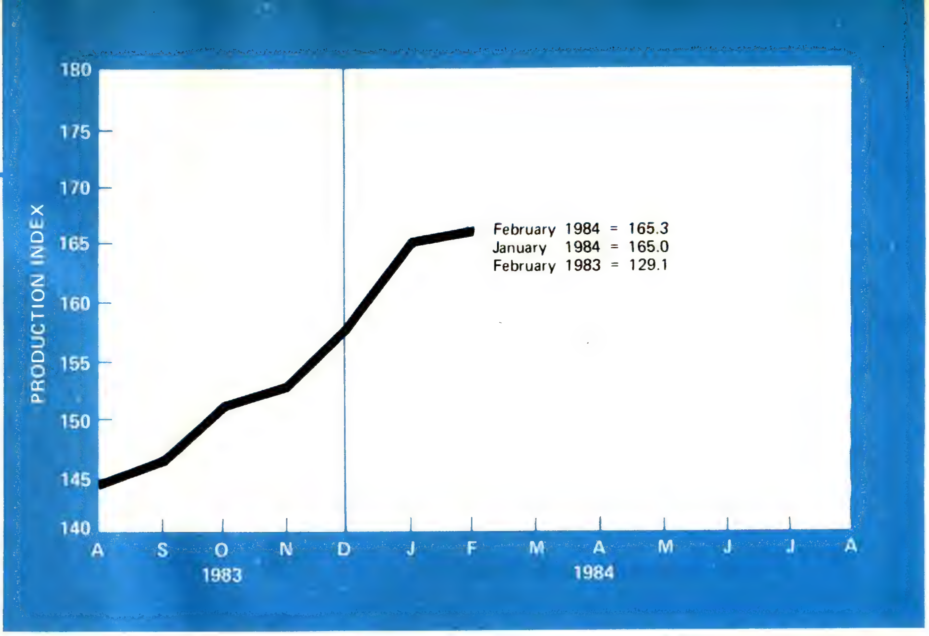
The U. S. consumer's love affair with the personal computer will continue this year, and the ardor will start to spread more deeply throughout the market for personal-computer peripheral equipment, according to the latest findings of a survey of U. S. households. *Industrial Marketing Research Inc.'s* quarterly Continuing Consumer Intent To Buy Survey shows that 9.4% plan to buy a personal computer in the coming 12 months, compared with the previous survey's 9.0% [*Electronics*, Feb. 23, p. 33]. The Hinsdale, Ill., firm says that in the peripherals market, 7.1% plan to purchase printers to use with their personal computers, up from 5.8% in the last survey, while 4.3% plan to acquire a disk drive, up from 3.6%. Also, 2.5% will add a monitor, versus 2.2% who planned to do so in the last survey. In addition, 2.2% plan to get modems for their computers in the coming year, compared with 2.1% in the previous survey, and 2.0% will buy a data cassette recorder, up from 1.3% last time. However, the proportion of households planning to acquire additional memory for their personal computers is down to 2.3%, from 2.5% in the last survey. But the proportion of U. S. households planning to buy software for personal computers will total 10.1% in the next 12 months, compared with 7.7% in the previous survey.

The proportion of U. S. households planning to buy color television sets in the coming 12 months totals a strong 21.9% in the latest survey, but this figure is down from the 23.6% that planned to buy a new set in the last one. Those planning to buy black-and-white TV sets also dipped a bit, to 4.4%, from 5.0%.

Company financings . . . *WaferScale Integration Inc.'s* first round of financing netted $16 million in equity and equipment leaselines. The Santa Clara, Calif., firm hopes to make application-specific integrated circuits and will now build a fabrication line. . . . *Natural MicroSystems Corp.,* Needham, Mass., raised $1.25 million in its initial round of financing. The company plans to develop telephone-management products that operate on personal computers. . . . A third round of venture-capital financing brought $9.5 million to *Cadlinc Inc.*, Elk Grove Village, Ill., maker of computer-integrated-manufacturing systems. . . . *Teknowledge Inc.*, Palo Alto, Calif., sold $3 million of preferred stock to General Motors Corp., giving GM 11% of the knowledge-systems software firm. . . . Data-transmission-systems maker *Digital Microwave Corp.,* Santa Clara, Calif., raised $3 million in its first round of financing. –**Robert J. Kozma**

Business activity

The *Electronics* production index is a seasonally adjusted measure of the level of production activity among U. S. manufacturers of office and data-processing equipment, communications and radio-television equipment, instruments, and components. As a reference point, the 1977 yearly average = 100.



February 1984 = 165.3
January 1984 = 165.0
February 1983 = 129.1

U. S. INDUSTRIAL-PRODUCTION INDEX[1]

	February 1984	January 1984	February 1983
Office and data-processing equipment	311.7	316.4	247.0
Communications equipment	195.3	192.6	170.5
Radio and TV equipment	111.5	112.3	80.7
Electronic and electrical instruments	168.7 (March '84)	168.4 (Feb. '84)	154.0 (March '83)
Components	430.9	419.3	318.6

U. S. ELECTRONICS ECONOMIC INDICATORS

Production workers[2] (thousands)	February 1984	January 1984	February 1983
Office and computing machines	200.5	198.6	188.5
Communications equipment	272.8	270.2	262.0
Radio and TV receiving equipment	62.8	62.4	58.6
Components	398.2	388.2	318.9

Shipments[3] ($ billions)	February 1984	January 1984	February 1983
Communications equipment	4.209	3.956	3.743
Radio and TV receiving equipment	0.782	0.935	0.649
Electronic and electrical instruments	4.426	4.490	3.954
Components	3.500	3.420	2.686

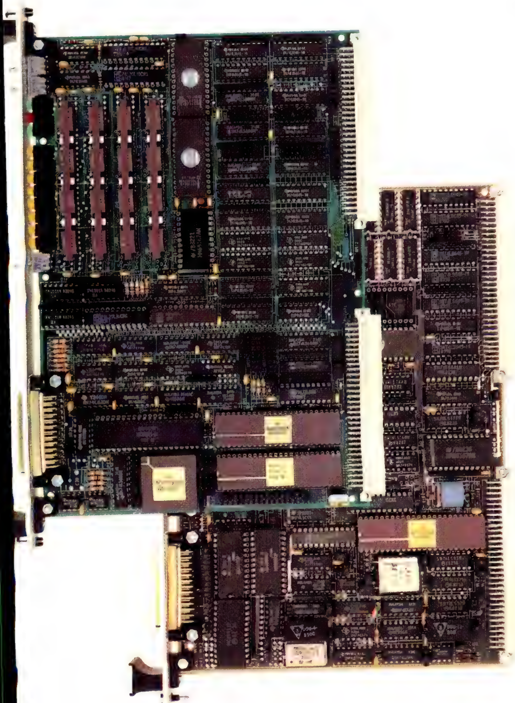
U. S. GENERAL ECONOMIC INDICATORS

	February 1984	January 1984	February 1983
Index of leading economic indicators[4]	165.9	164.8	147.4
Budgeted outlays of the Federal government[5] ($ billions)	68.267	68.052	64.152
Budgeted outlays of the Department of Defense[5] ($ billions)	18.515	18.283	18.283
Operating rate of all industries[6] (% capacity)	80.6 (March '84)	80.5 (Feb. '84)	71.6 (March '83)
Industrial-production index[1]	160.7 (March '84)	160.0 (Feb. '84)	140.0 (March '83)
Total housing starts[3] (annual rate in thousands)	1,638 (March '84)	2,231 (Feb. '84)	1,592 (March '83)

Sources:
[1] Federal Reserve Board (1967 = 100) [2] Bureau of Labor Statistics [3] Bureau of the Census [4] Department of Commerce (1967 = 100)
[5] Department of the Treasury [6] McGraw-Hill Publications Co., Department of Economics

VME ARENA CHAMPIONSHIP

N THE VME ARENA FORCE PUTS MORE POINTS ON THE BOARD



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- 128K bytes of EPROM
- 3 serial I/O ports plus 1 parallel I/O port
- Real time clock with battery back-up

256KB/1MB 68000 CPU-2 VMEbus Board SYS68K/CPU-2

- Dual ported RAM 256K/1M byte
- 16K bytes of SRAM, 64K bytes of EPROM
- Floppy Disk Controller (5 1/4 ", SA 460)
- Multiprocessing, multimaster capability
- 1 serial multiprotocol plus 1 parallel port
- Real time clock and battery back-up capability

MMU-DMA 68000 CPU-3 VMEbus Board SYS68K/CPU-3* (Preliminary Spec.)

- Memory Management Unit
- Direct Memory Access Controller
- 16K bytes of SRAM, 64K bytes of EPROM
- 4 level on-board bus arbiter
- Multiprotocol controller
- Real-time clock with battery back-up

Other FORCE products of the SYS68K VMEbus family:

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- Static RAM boards
- Floppy/Winchester controller
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D-8000 München 81
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Circle 35 on reader service card

THE CASE F

No, we're not talking about the shipping container. Our *"Case For Quality"* has to do with the product housed within it—namely, another shipment of Xebec S1410 controllers for yet another in a long list of OEM customers. A list of customers that has made this board the best selling disk controller in the world—and has helped turn its creators into the industry's largest independent manufacturer of disk drive controllers.

The evidence is persuasive. First, the superior quality of design resides with a team of engineers that has been setting standards in disk controller technology for almost a decade. Quality that continues to be supported by the most sophisticated CAD equipment of its kind in the country. Little wonder, then, that the S1410 reached the market as such a feature-rich offering. With patented VLSI architecture. Industry-standard SASI host bus. Automatic data error detection and correction, seek and position verification, command retry on drive errors, and alternate track capability. Extensive controller and disk drive diagnostics and hardware-selectable sector size. All on one compact PCB that fits the 5.25″ form factor.

Translating a superior design into superior finished goods leads us to submit *"The Case For Quality's"* second major piece of evidence: Superior quality of manufacture. This evidence includes the use of the most sophisticated and automated production facilities in the industry. A $20 million investment in computer-aided manufacturing, from advanced robotic devices to automatic insertion equipment to ATE.

The most convincing testimony in *"The Case For Quality"* comes from the customers. Customers like IBM, Lanier, Hewlett-Packard, Eagle, ICL, CPT, and Phillips. Customers who have chosen Xebec because "time to market" and "cost to market" are critical considerations. And most importantly, perhaps, customers who know that when a shipping case with our "Xero D" quality signature on its side arrives on their shipping dock, it can go right to stock.

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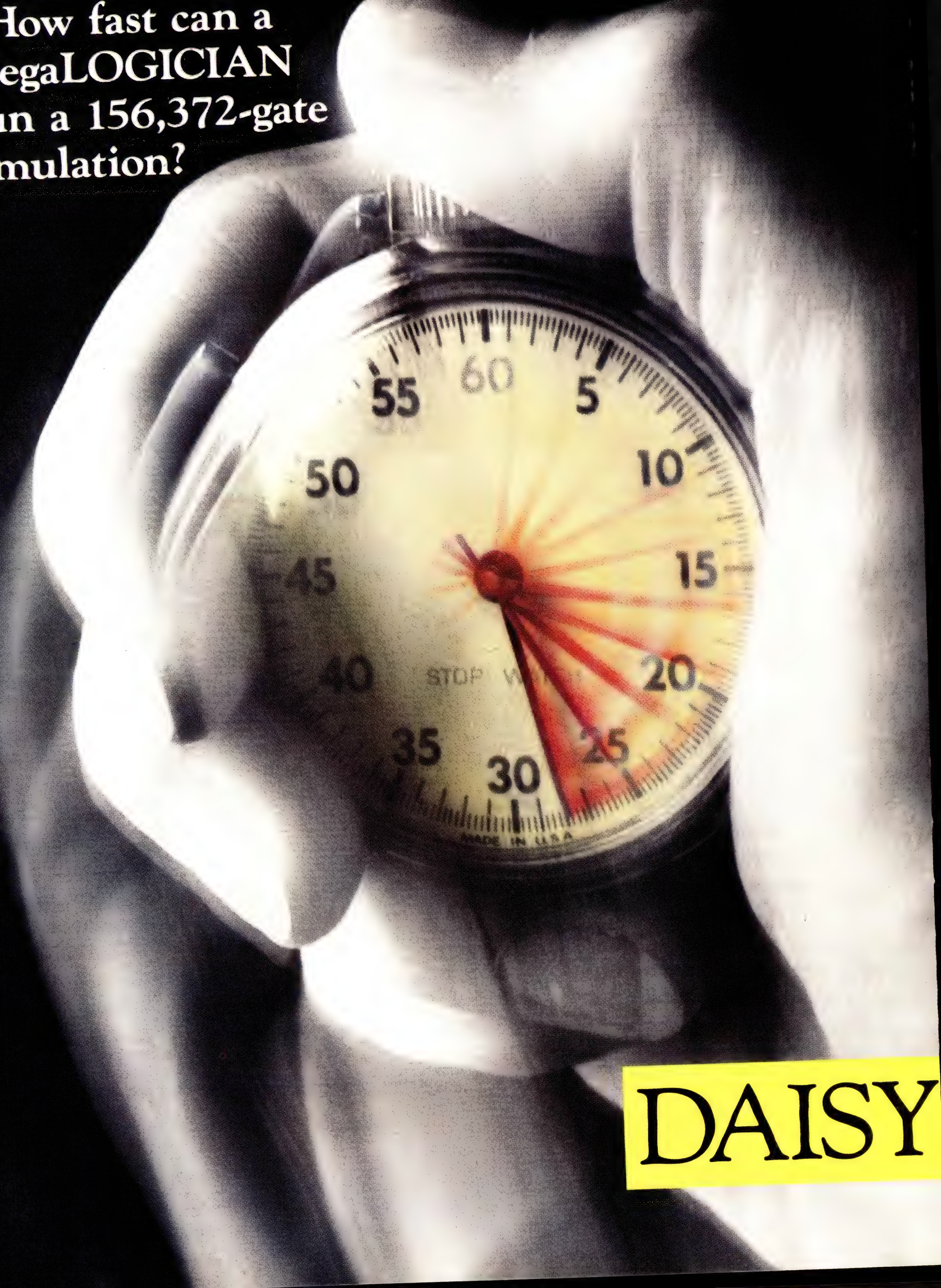
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Why do you need a CAE system capable of running 100,000 evaluations per second, with a capacity in excess of 1,000,000 gates?

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The MegaLOGICIAN couples the most advanced microprocessor technology with Daisy's pipelined hardware simulation accelerator.

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Plug the MegaLOGICIAN right into your existing Daisy network. Accelerate *every* engineer on line.

Our new product announcements are designed to integrate with (and accelerate) your expanding Daisy Engineering Environment™. Investment protection? Like money in the bank.

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For information on how Daisy CAE workstations can accelerate *your* next product introduction, call 408-773-9111 today.

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*Based on 500 system clocks, 15% gate activity.

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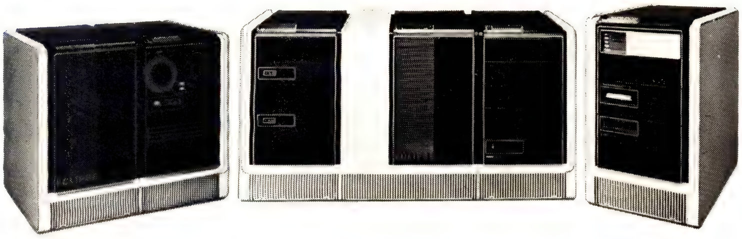

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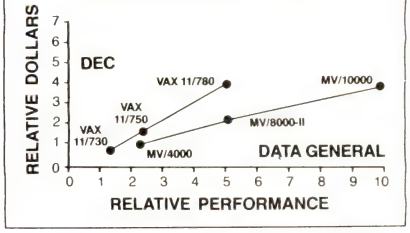

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a Generation ahead.

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Electronics newsletter

10 firms agree on standard architecture for PBX interface chip

To spur the development of all-digital communications networks in a field with myriad architectures, an international group of 10 semiconductor and telephone-equipment manufacturers has agreed on a new architecture for standard interface chips to be used in internal private-branch exchanges and central offices. One of the firms is Intel Corp., of which International Business Machines Corp. is a major owner; another is Texas Instruments Inc., which like Intel is known to be working with IBM on the local network that the giant computer maker says is two to three years away. An advantage of the new approach, say the firms, is that by merging voice and data functions, **it should greatly expand capabilities of existing PBX and central-office networks.** Participating semiconductor firms, in addition to Intel and TI, are: Harris, Matra-Harris, Philips-Signetics, Siemens, and SGS-Ates. Phone-equipment makers are: CIT-Alcatel, L M Ericsson, and Siemens.

3270-type terminal includes windowing at low cost

The fires in the rapidly heating market for gear compatible with International Business Machines Corp.'s 3270-PC were stoked further last week, when Lee Data Corp. announced software-windowing capability on a low-cost 3270-type terminal that does not have PC functionality. The Minneapolis firm's model 1221W, to be shipped in October, will feature four-section windowing in a terminal priced at $2,866. By comparison, IBM's 3270-PC, which includes windowing and PC functionality, has a base price of $5,885 [*Electronics,* Jan. 12, p. 109]. **Lee Data's 1221 family also matches several functions included on the 3180,** IBM's latest low-priced 3270-line terminal, which lists for as low as $2,195 and does not include windowing.

Mostek, AMI plan double-level-metal standard-cell C-MOS line

As part of Mostek Corp.'s effort to diversify beyond its semiconductor business (see p. 14), the Carrollton, Texas, firm plans to expand its semicustom-chip activity into standard-cell markets this fall with a double-level-metal complementary-MOS process. The 3-μm cells will also be marketed by Mostek's partner in C-MOS gate-array markets, American Microsystems Inc., of Santa Clara, Calif. **The double-level-metal process is expected to greatly improve propagation gate delays** over today's C-MOS standard cells, most of which are made of one level of metal and one of polysilicon. The polysilicon material has about 1,000 times the resistance of metal, slowing interconnections. The difference in resistivity between the two layers also causes uncertainty during initial design, before circuits are placed and routed.

TI puts linear chips in allocation program

The exploding demand for semiconductors shows no sign of abating. In fact, it is spreading: in an effort to stem overbooking of hard-to-get linear chips, Texas Instruments Inc., of Dallas, has initiated a computer-based allocation program designed to more closely match promised deliveries four months away with anticipated fabrication capacity. The program is similar to one begun a year ago by TI in the booming bipolar logic market and employs what is called a bucket concept: **once orders fill a 16-week bucket, new orders are pushed out to the next lot, or bucket.** The real-time computer system tracks total capacity build-up against order rates. The company says scheduled orders are based on a customer's history of purchase agreeements.

Electronics newsletter

GM-Fanuc robot firm to take top U. S. spot

Though only two years old, the joint venture in robotics between Detroit's General Motors Corp. and Japan's Fanuc Ltd. is driving rapidly to a place of prominence. Indeed, the Troy, Mich., concern, known as GMF Robotics Corp., is expected to pass long-established robot makers Cincinnati Milacron and Westinghouse/Unimation into the No. 1 spot this year among U. S.-based robot vendors, maintains Laura Conigliaro, a robots specialist at Prudential-Bache Securities, in New York. **GMF will snatch 18.7% of a $375 million robot market in 1984, up from last year's third-place finish at 9.2% of a $240 million market, she predicts.** Cincinnati Milacron and Unimation market shares will drop to 16.8% and 9.6%, respectively, from 21.3% and 15% in 1983.

HP's portable computer features 272-K-byte RAM

The long-awaited notebook-sized computer unveiled by Hewlett-Packard Co., Palo Alto, Calif., this month weighed in, as expected, at 9 lbs, including a flip-up liquid-crystal display of 16 lines by 80 columns. There were some surprises: HP provides a user-partitionable 272-K bytes of random-access memory for permanent data storage in addition to system memory, plus built-in software in the form of 384-K bytes of read-only memory. All chips are complementary-MOS, including the 80C86 microprocessor. Called The Portable, **the system runs MS-DOS programs and is compatible with the IBM Personal Computer as well as the HP 150** through the use of optional hardware and software. It can communicate with other machines through a serial interface and the HP interface loop, as well as with a 300-baud modem. An external disk drive provides another surprise: it is the first double-sided version of the Sony 3½-in. floppy, which holds 710-K bytes. Cost is $2,995.

Software integrates IBM, DEC machines

Cincom Systems Inc. is expected this week to unveil a network-management system that it says will unite mainframes from International Business Machines Corp. and VAX superminicomputers from Digital Equipment Corp. The product, known as Net/Master is designed to work with the Cincinnati company's TIS and Ultra relational data-base-management systems that it offers for IBM Systems Network Architecture and DEC VAX environments, respectively. Since those two systems are the same architecturally, Net/Master **will enable complex networks involving both IBM mainframes and VAXs to be run as a single operating unit,** Cincom sources say.

Addenda

Burroughs Corp., of Detroit, has introduced a line of desktop microcomputers **based on the N-Gen and MegaFrame products that Burroughs licenses from Convergent Technologies Inc.,** of Santa Clara, Calif. The 80186-based N-Gen provides the modular, plug-together B 25 desktop work stations; the MC68010-based MegaFrame is used by Burroughs as its XE520 shared-resource processor. This new line will be sold to larger users worldwide by Burroughs' sales force and to smaller and first-time users through a dealer network Burroughs is putting together. . . . Eastman Kodak Co., of Rochester, N. Y., seeking to expand its electronics activities, **has become the 16th shareholder to join Microelectronics & Computer Technology Corp.,** the Austin, Texas-based research and development consortium.

What kind of operator do you design for your terminals?

When you design a work station, you naturally look for positioning and tracking controls that will permit optimum efficiency, speed and accuracy. Yet, sometimes the most critical link in the entire system is neglected.

The operator.

No matter how good positioning and tracking controls may be, their effectiveness is diminished in proportion to the difficulty in using them. Obvious? Yes. Disregarded? Often.

But not by Measurement Systems.

We're a leading designer and manufacturer of joysticks, trackballs and control grips. From our beginnings a quarter of a century ago, we've recognized the importance of the human element in successful equipment design. We've spent substantial time and money researching the interaction of man and machine. We've become experts in the human factors in control design.

We've put our extensive knowledge to good use. For example, a joystick that's perfect for one type of application is often totally unsuitable for another. So we offer joysticks in numerous sizes and models, each with features suitable for the special requirements of dissimilar applications.

Versatile as they are, if our standard models don't meet your needs, we'll work closely with you to design one that does. If you're designing a system, we'll assist you. Whether your design requires point-to-point positioning, tracking, mapping, processing or something more exotic, we can help.

Nor does it matter to us if you're a Fortune 500 company or a considerably more modest enterprise. You can count on us to respond to your needs with the same enthusiasm and thorough professionalism.

Let us help you put the human touch in your equipment. Talk to us. Write or call:

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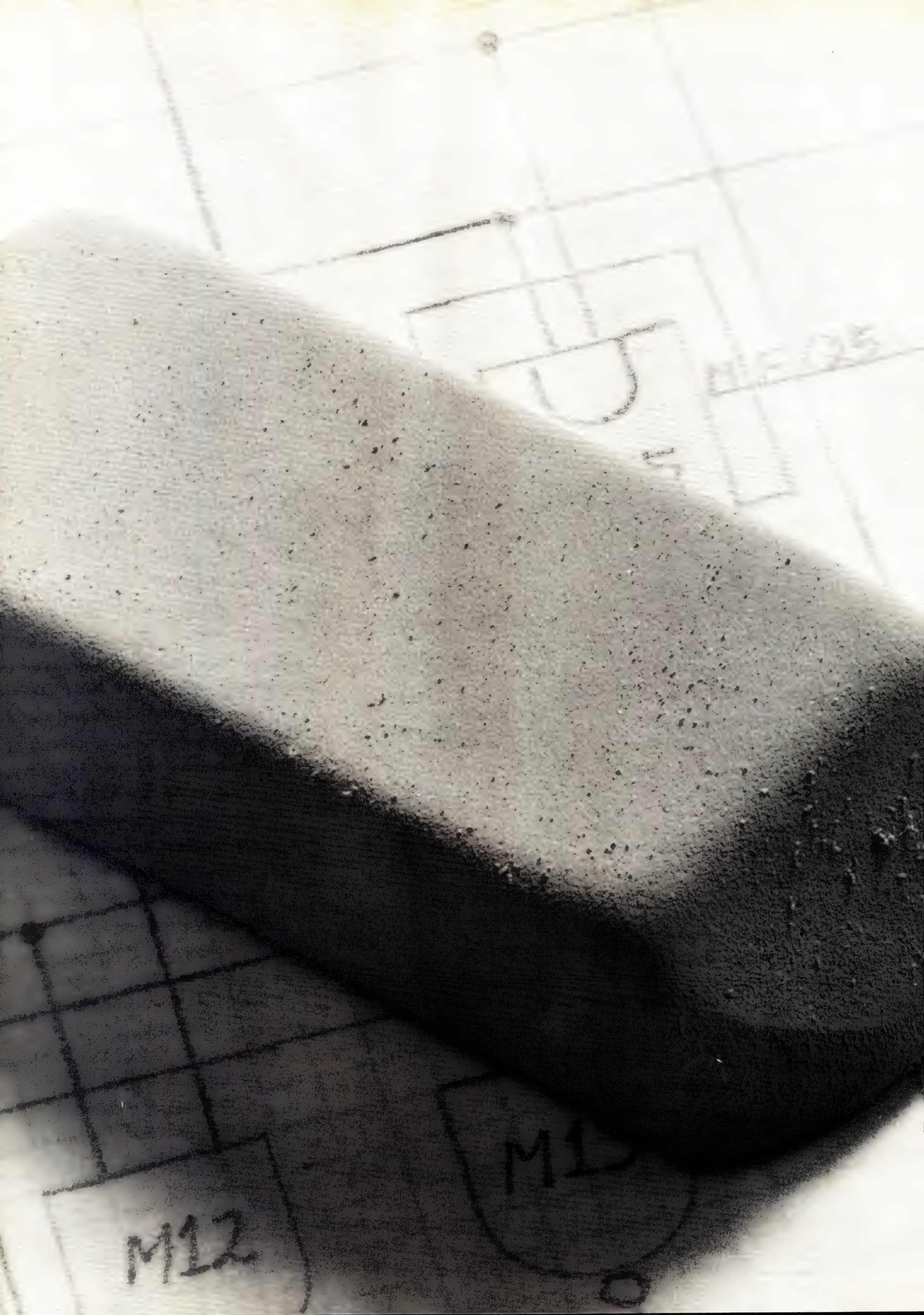
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1500 gate MegaPAL™ arrays: The gate array alternative that offers instant development of silicon systems.

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Fortunately, there's a better alternative.

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The first of these is our PAL32R16.

With it, you can design using 1,500 gates of PAL® logic per part.

And do things never before possible.

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Of course, this MegaPAL array offers all the other benefits of PAL circuits. Like prototypes in hours rather than weeks. And pre-tested circuitry.

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Best of all, you can develop your own gate array alternative in no time at all.

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It's no wonder we call it the gate eraser.

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IdeaLogic. The big idea in system design.

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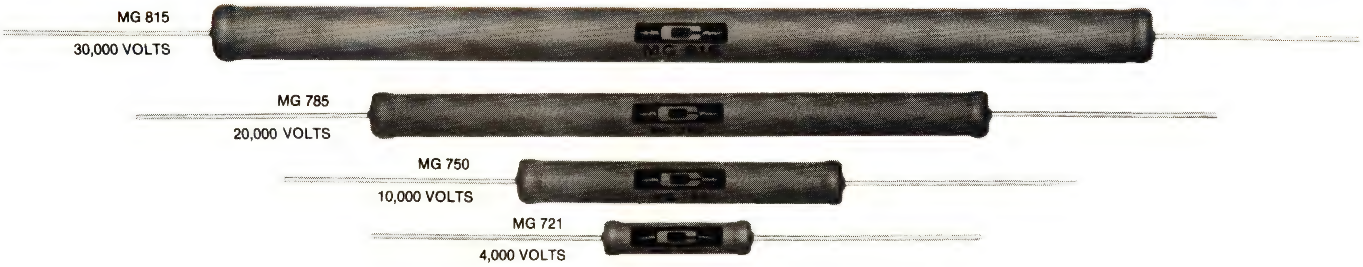
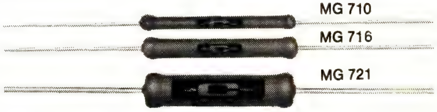
Type MG Precision High Voltage Resistors from CADDOCK deliver 6 big advantages:



1. For maximum design flexibility, there are 19 standard models with 10 voltage ratings in the Type MG 'family'.

The Type MG family of high voltage resistors includes a selection of voltage ratings from 600 volts to 30,000 volts in various resistor lengths to provide maximum flexibility in the design of high voltage assemblies.

In addition to this wide range of voltage ratings, the Type MG family provides a selection of resistor diameters at many of the standard voltage ratings, as illustrated by the three models of 4,000 volt, 1-inch long resistors shown here.



Important performance specifications for all Type MG resistors include:

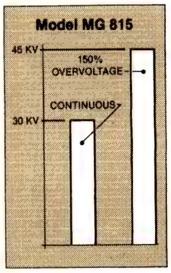
- Full power rating to + 125°C.
- + 225°C maximum operating temperature.
- Resistance values that cover the range from 200 ohms to 2000 Megohms.

2. The standard TC of 80 PPM/°C and resistance tolerances from 1.0 % to 0.1% combine to improve circuit accuracy.

Through the full range of resistance values from 200 ohms to 2000 Megohms, the Type MG resistors maintain a temperature coefficient of 80 PPM/°C over the range from − 15°C to + 105°C, referenced to + 25°.

The combination of precision and low TC achieves a significant improvement over other high voltage resistor technologies, particularly in the higher resistance values.

3. Overvoltage rating of 150% is standard for all models.



Every model of the Type MG resistors has a *standard* overvoltage/overload rating of 1.5 times the maximum working voltage where this level does not exceed 5 times the rated power. As an example, in the Model MG 815 this capability provides for short-term overloads as high as 45,000 volts.

And for even tougher applications, special factory conditioning can boost the maximum *continuous* operating voltage of many models to 160% above the standard specifications.

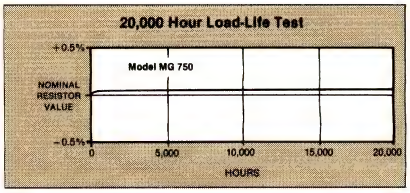
4. Exclusive Non-Inductive Performance.

Caddock's Exclusive Non-Inductive Design is the answer wherever there are special requirements for excellent high-voltage pulse fidelity and wide bandwidths.

To keep the inductance to an absolute minimum, the special serpentine pattern provides for neighboring lines to carry the current in opposite directions to achieve maximum cancellation of flux fields over the entire length of the resistor.

5. Extended-life stability that is typically better than 0.02% per 1000 hours.

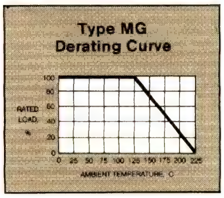
20,000 hour *continuous* load-life tests have proven the exceptional stability of Caddock Micronox® resistance films. This graph illustrating the 20,000 hour test results of the 10,000 volt rated Model MG 750 shows extended-life stability well within 0.02% per 1000 hours.



A complete data summary of these test results is available on request.

6. High stability at operating temperatures up to +225°C.

The Type MG resistors are capable of continuous operation at temperatures as high as +225°C, as shown in this "Derating Curve". This high temperature operation capability is confirmed by a +300°C temperature soak of every Type MG resistor prior to final inspection.



The high stability of the Type MG resistors through extended-life and through temperature extremes gives engineers increased confidence and the critical edge in the design of medical, laboratory, geophysical and industrial instruments.

Caddock's advanced film resistor technology is the source of these outstanding advantages - advantages that are matched by a 20-year record of outstanding in-circuit reliability.

Discover how easily these problem-solving resistors can improve the performance and reliability of your equipment, too. For your copy of the 20th Edition of the Caddock General Catalog, and specific technical data on any of the more than 150 models of the 13 standard types of Caddock High Performance Film Resistors, just call or write to -

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HIGH PERFORMANCE FILM RESISTORS

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U. S. makers prepare to start shipping 256-K dynamic RAMs

by J. Robert Lineback, Dallas bureau

Delays caused by big sales of 64-K models have left time to upgrade designs, including downsizing for plastic packages

A little later than the optimistic targets set two years ago, U. S. chip manufacturers are at last gearing up for their first volume shipments of 256-K dynamic random-access memories in the second half of 1984. Much of the delay resulted from the new high-density RAMs' butting up against swift sales of maturing 64-K chips. But while memory customers have been making record runs on 64-K chips, makers have not kept 256-K designs and processing idle.

For some, the extra time has meant a wider window for the transition from n-channel- to complementary-MOS technologies for low-power dynamic RAMs. Others have fine-tuned advanced n-MOS and chip layouts. Nearly all are now planning to enter the 256-K business with dice small enough to be housed in low-cost plastic dual-in-line packages.

Such is the case with Motorola Inc., scheduled to officially unveil its 55,000-square-mil MCM6257 256-K dynamic RAM at this week's Electro show, in Boston. No pricing has been set, but samples of the n-MOS 6257 will be available in the third quarter. Volume production of chips in standard 16-pin plastic DIPs will begin in the fourth quarter. Like other U. S. firms, Motorola is entering the market behind the Japanese (see "Churning 'em out in Japan," right). A page-mode MCM6256 chip will also bow soon, and Motorola's memory operation, in Austin, Texas, is readying C-MOS and 64-K-by-4-bit dynamic RAMs for introduction early in 1985.

Motorola planned its first 256-K RAM with a double-level polysilicon process using low-resistivity silicide interconnections. But it has switched to a triple-polysilicon process [*Electronics,* Dec. 1, 1983, p. 42].

This process, with 2-micrometer geometries, needs no tricky silicide levels and has yielded smaller dice since it stacks interconnections in three layers. Motorola also plans to use the process on a new C version of its 64-K-by-1-bit RAM, now slated for introduction in early 1985.

In addition to the triple-poly process, Motorola has shaped its 256-K RAM for speed, laying out the memory cells in thin arrays for shorter polysilicon bit lines, says Betty Prince, strategic marketing manager. The elongated die, measuring 159 by 349 mils, has long word lines, which are formed from low-resistivity aluminum. In addition, the MCM6257 has open-bit sense lines. The result is a speed of 100 to 150 nanoseconds.

Texas Instruments Inc. and Intel Corp., not yet ready to unveil their 256-K-by-1-bit chips, have been providing limited numbers of samples in plastic. Expected to introduce its 256-K RAM by midyear, Intel, of Santa Clara, Calif., will reportedly fabricate the chip from its high-speed C-MOS (C-H-MOS), which is being used to boost access speeds of a new 64-K chip [*Electronics,* May 3, p. 217].

Package work. Dallas-based TI launched a major plastic-packaging development effort at the same time chip designers were laying out its scaled n-MOS 256-K chips, dubbed TMS4256 and 4257 (both page mode). The aim was to reduce the risk of contamination of high-density dies by humidity or the cracking of plastic by changing temperatures.

TI's 256-K chips, made from a polysilicon layer, a silicide interconnection, and metal, are expected to be available in the second half of 1984. Already, the firm is reportedly producing 100,000 256-K chips a month at its Miho, Japan, plant, with a target of over 600,000 in the fall. Officials in Texas decline to comment on production.

In Carrollton, Texas, Mostek Corp., which has already provided limited samples of its plastic-housed 28-pin 32-K-by-8-bit MK4856 [*Electronics,* Aug. 25, 1983, p. 49], will use the same technology (lightly

Churning 'em out in Japan

As U. S. manufacturers of 256-K dynamic random-access memories prepare to inaugurate volume production, they know that they are playing catch-up with the Japanese, who have been making 256-K RAMs in volume since late 1983. Fujitsu Ltd. says it will make 400,000 a month by July and nearly 700,000 by 1985. Hitachi Ltd. and NEC Corp. are each producing 200,000 chips a month; both plan to reach a monthly rate of 700,000 in December. Toshiba Ltd. says it is now producing about 100,000 a month, while Mitsubishi Electric and Oki both plan to ramp up monthly production to 100,000 units this summer. **—J. R. L.**

doped drain, triple-diffused MOS) to produce the 256-K-by-1-bit MK4556. Mostek officials intend to place the chip in a standard 16-pin plastic DIP, but the current die size—4.75 by 9.85 millimeters—is too large for such a package.

Also in the second half of 1984, Inmos Corp., of Colorado Springs, Colo., plans to introduce a high-performance C-MOS 256-K chip featuring a new static column-decoding scheme aimed at faster system-access speeds [*Electronics,* May 3, p. 56]. National Semiconductor Corp., of Santa Clara, will begin shipping samples in early summer of its own 256-K design made from a triple-polysilicon process. By December, Micron Technology Inc., of Boise, Idaho, plans to make available its double-polysilicon n-MOS 256-K RAM in plastic.

The first U. S. supplier to ship samples of 256-K chips, AT&T Technologies, now estimates that growing internal demands, bolstered by its recent entry into the computer business, will limit its early activity on the open market.

Communications

High-definition-TV scheme exploits inability of eye to detect all details of moving images

Research into the workings of human vision has led to a new development in high-definition television—a video-transmission scheme that not only is compatible with existing TV receivers but is targeted at delivery systems ranging from terrestrial broadcast and cable TV to direct-broadcast-satellite service. It makes possible high-detail video while protecting the dynamic resolution for spatial frequencies (movement of full swings in image intensity) below 3 cycles per degree.

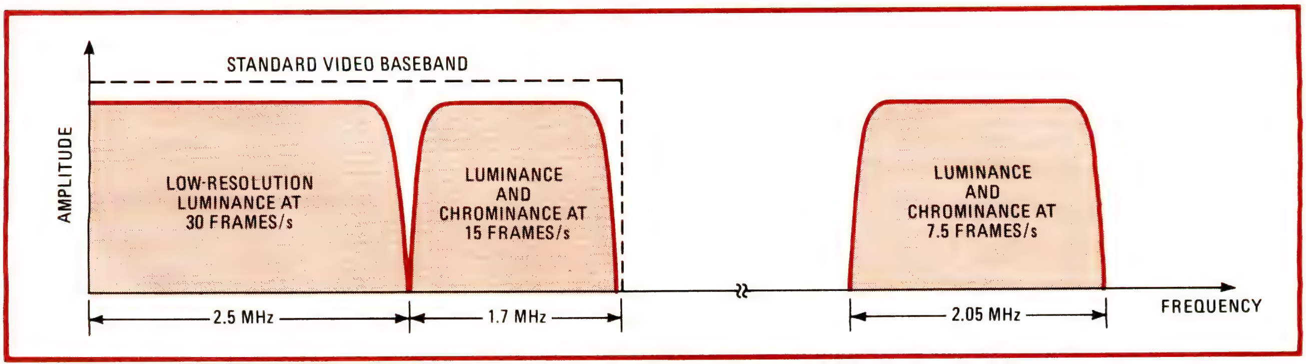
The transmission scheme exploits the human visual system's relative inability to discriminate detail in moving images, a factor that other TV systems do not take into account. In fact, "about three quarters of the information in a conventional television transmission is not seen," claims William E. Glenn, director of the New York Institute of Technology's Science & Technology Research Center, in Dania, Fla. He expects that the eye will find his system's picture like that of 35-millimeter film.

In a paper presented at the National Association of Broadcasters' convention, at Las Vegas in late April, Glenn describes the process in which he and his associates have opted to "take the average intensity over two periods of time and display that twice, and take the average chrominance over two periods of time and display that twice" for the conventional signal's 2.5-to-4.2-megahertz bandwidth. The scheme leaves the portion below 2.5 MHz untouched while adding a 2.05-MHz channel—to carry the slow-scan detail—at an arbitrary allocation, say in the ultra-high-frequency region or an unused slot in cable-distribution systems.

The transmission scheme's goal is to match the requirements of human vision, which can be modeled as two parallel channels. The transient neuron channel has poor spatial resolution but high temporal resolution. It detects motion, while the sustained neuron channel, with its high spatial and low temporal resolutions, performs the high-detail-processing on stationary images. The Dania researchers have found that when a scene changes rapidly, the transient neuron system dominates, and spatial frequencies above 3 cycles per degree need not be presented.

Unseen loss. The viewer of a standard TV receiver does not perceive a loss if both the luminance and chrominance components above 2.5 MHz in a conventional-baseband video signal are averaged for two successive frames, say the researchers. A frame store in a high-definition receiver is used to add and subtract the two images. Taking advantage of the color subcarrier's phase reversal between successive frames, the sum gives the luminance signal (without any color carrier), and the difference gives the color signals without cross color. The frame rate in both cases is 15 frames per second (see figure).

Over and above compatibility with existing TVs and the elimination of cross-color and cross-luminance in the demodulated signal, Glenn and his associates have added the separate 2.05-MHz channel to carry high-detail information. Because motion is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LUMINANCE AND CHROMINANCE AT 7.5 FRAMES/s
2.5 MHz
1.7 MHz
2.05 MHz
FREQUENCY

Unlocking the door. A high spatial-resolution added-on channel may be the key to high-definition TV signals. The 2.05-MHz detail channel carries no temporal information, so it scans slowly. Below 4.2 MHz, the scheme modifies the video signal, which is compatible with today's signals.

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TeleSoft-Ada at Work: Production Software Enhances Army C^3

The Singer Company's Librascope Division, Glendale, California, has been using TeleSoft-Ada to develop control programs for three interrelated Army C^3 Systems—an updated AN/UYQ-30 Tactical Computer Terminal, an updated AN/UGC-137 Communication Terminal, and a Communication Control System. A communications protocol links the Army's Maneuver Control System (MCS) to the West German HEROS and other NATO C^3 systems. Singer and the Army went with TeleSoft-Ada only after they determined it was a mature system with a clear future growth path.

The UYQ-30 and UGC-137 are undergoing architecture and performance upgrades from 8-bit to 16-bit processors for CPU, modem and off-line functions. Singer engineers are using TeleSoft-Ada tools to program CPUs in Ada now, and modems in Ada at a later date. For the MCS/HEROS interface, Singer programmed a 16-bit CPU and modems with the ISO-OSI 7-layer X.25 packet switching model. Initial testing of the first phase has exceeded expectations.

Singer expects the software generated for these projects to have universal application to all of Librascope's Army programs, since they all contain common hardware and processors and have overlapping communications requirements.

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handled by the portion of the signal below 4.2 MHz, the requirements for updating the detail information drop to 7.5 frames per second. As with other high-definition systems, the use of diagonal sampling is recommended to take advantage of the "oblique effect," a phenomenon that enhances horizontal and vertical spatial resolution. –**Terry E. Feldt**

FCC frees up spread spectrum

Local networks that transmit and receive data over the air? This is a big potential market, experts agree, now that the Federal Communications Commission has unshackled spread-spectrum technology for use in the commercial world.

"If it doesn't cause harm, then let's get out of the way" is how Michael Marcus, chief of the FCC's technical-analysis division, explains the philosophy behind the agency's imminent decision to allow spread-spectrum modulation to be applied widely. Previously spread spectrum had been licensed on an exceptional basis only.

Users of low-power devices operating above 70 megahertz and with communications ranges in the tens of meters would be able to buy and operate spread-spectrum equipment without seeking prior FCC approval. That rule would affect such gear as wireless microphones, says Marcus, who expects the move to stimulate the development of other products, such as cordless telephones.

The change was prompted by spread spectrum's potential for multiple band sharing at a time when communications users are clamoring for more channels in the limited spectrum. The technology's benefits have been demonstrated previously by the military and in long-haul communications. For example, in late 1980 Equatorial Communications Co., Sunnyvale, Calif., started using it in earth-station receivers to minimize interference from adjacent satellites.

Two years ago, Del Norte Inc., Euless, Texas, received an experimental license to demonstrate spread spectrum's sharing potential. The firm was assigned frequencies in the 400-MHz range—also used by the amateur-radio community—to market radios for measuring distances in mineral and mining surveying.

Spectrum spreading is a form of modulation in which baseband information is transmitted in a much wider bandwidth than is required. At the receiving end, the incoming signal is correlated with the same code that did the spreading at the transmitting end. The output of the correlation is the desired signal extracted amid the noise and interference generated by other transmitters in the same band. Frequency can be shared because less spectral-power density is used—a total of 20 to 30 decibels—than in other conventional modulation techniques, such as fm and a-m.

Four ways. Spreading can be done in four ways. These are:

- Direct sequence: the baseband information is modulated with a pseudo-noise signal that has a higher rate than the baseband signal.
- Fm chirp: rather than transmit the information on a fixed signal, spreading varies the frequency of the carrier, usually from a lower to a higher frequency.
- Frequency hopping: the signal is spread around from one channel to another.
- Time hopping: the signal is assigned time slots in which to jump around.

The evidence shows that direct sequence is the most efficient approach to local networking, says Brian Elliott, who is a spread-spectrum specialist at Hewlett-Packard Co., Palo Alto, Calif. Experiments conducted by the firm at 2,500 MHz have been successful in transmitting data at up to 100 kilobits a second, Elliott reports.

Having invested more than $1 million in research, development, testing, and evaluation over the past three years, HP is considering whether to go ahead with commercial production now that regulatory obstacles have been removed. Inviting markets extend beyond the office. Remote control of robots and forklifts in factories where hardwiring is both expensive and dangerous is just one obvious application, argues Elliot. –**Karen Berney**

Government

Groups led by Rep. Zschau and HP's Young offer blueprints to spur U. S. high-tech efforts

Republicans working on Capitol Hill and for the White House advanced 14 proposals early this month to spur U. S. high-technology industries. Concrete legislative proposals from the congressional group are balanced by longer-term ones from a White House task force.

Led by California's Rep. Ed Zschau, the Republican Task Force on High Technology laid out its legislative plans to provide tax credits and similar incentives to industry and academia. At the same time, the President's Commission on Industrial Competitiveness, chaired by Hewlett-Packard Co. chief executive John Young, made public its first six recommendations.

Although both Republican plans are distinctly similar to earlier calls by Democrats for a national industrial policy, Zschau and his colleagues insist that their proposals would not create a Government-managed program. The Republicans speak of "targeting innovation," not of supporting threatened industries.

Zschau maintains that the plan embodied in the bill from Rep. John J. LaFalce (D., N. Y.) to create a Council for Industrial Competitiveness to coordinate tax, trade, and related policies and to fund an $8.5 billion Bank for Industrial Competitiveness "would be doomed to failure." According to Zschau, "the history of Federal handouts indicates

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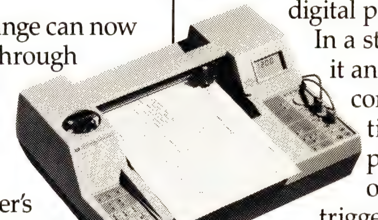

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that the money is often given to the industries and regions who are the best represented in Washington rather than on the basis of potential."

But, a spokesman for LaFalce replies, "companies seeking assistance would have to adhere to a strict program to improve their competitiveness. Zschau and the Administration refuse to address the reality of what the Government does now. We want to focus on the the $100 billion annually that the Federal government hands out in assistance, and the trillion dollars aggregate. Zschau wants to focus on $8.5 billion."

Among key proposals of the Zschau task force are the following:

- Encouragement of joint corporate research and development ventures, such as the Semiconductor Research Corp., by modifying antitrust laws. On May 1, the House passed H. R. 5041, which would limit damages for anticompetitive joint R&D to those actually incurred rather than tripling them, as at present. A companion bill, S. 1841, has passed the Senate Judiciary Committee.
- A 25% corporate tax credit for funding basic research at colleges and universities. This provision may not pass into law before the election.
- Risk-taking incentives for companies. Such incentives have been included in several bills that, among other things, would increase safeguards for chip designs, raise tax incentives for corporate contributions of equipment to university science and engineering departments, and permit foreign nationals with technical skills to remain in the U. S.

Some of those proposals will probably pass, though the bill to permit skilled foreign nationals to remain in the U. S. and the plan to make an existing R&D tax credit permanent are exceptions.

Capitol Hill regards the first six proposals from the Young commission as more comprehensive than those in the congressional package. But they are also viewed as less likely to become law this year and more likely to serve instead as campaign ammunition for President Reagan.

On the issue of education, for example, the Young panel proposes incentives "to increase the number and quality of engineering graduate students and faculty members [as well as] increased funding and support for equipment and research." It also wants measures to increase classroom computer use and seeks to streamline and clarify antidumping and countervailing-duty measures. **–Ray Connolly**

Software

Software houses beginning to sweeten pot with mainframe-style microcomputer support

Vendor support for microcomputer-software users not connected with corporate accounts has ranged from fair to unpredictable to nonexistent, depending on the user's location and dealer. But now a number of companies with long records of extensive support in the mainframe arena are pushing into the microcomputer-software market with hard-earned repu-

Juicy market whets suppliers' appetites

Like wolves licking their lips at the sight of sheep, traditional mainframe-software vendors—such as Management Science America Inc., in Atlanta, Ga.—are hungrily viewing the microcomputer software market as their next meal ticket. It is big, and they think they have what it takes to gobble up a big chunk of it.

According to Future Computing Inc., a market-research firm in Richardson, Texas, sales of personal-computer software this year will total $2.2 billion, rising to $4.3 billion by 1986. A major attraction for mainframe-software vendors, besides the size, is the market's makeup. Future Computing estimates that about 23% of the 1984 market—or about $500 million—consists of large corporate customers, which have bought microcomputers in big quantities and want similar amounts of software. The percentage of the software market devoted to these large corporate accounts will grow to 27%—or $1.16 billion—by 1986. According to Input Inc., a Mountain View, Calif., research firm that keeps track of the software industry for the Association of Data Processing and Service Organizations, expenditures for packaged software for mainframes and minicomputers will grow from $6.6 billion in 1983 to $23.9 billion in 1988.

A strong nationwide distribution channel to corporate America, a large corps of savvy salespeople experienced in dealing with data-processing or management-information-systems departments, and the predilection of their customers to buy from just one software source are all the elements that mainframe-software vendors, such as MSA, are counting on to achieve success in this corporate market. "Companies like MSA and Cullinet will be very successful" in this arena, believes Curt A. Monash, a research analyst with Paine Webber Mitchell Hutchins Inc., New York. "They know how to sell to large organizations." Also, "they have a real edge with their installed base [of mainframe software]," maintains Ken Churilla, vice president of Creative Strategies International, a research firm in San Jose, Calif. In addition, he notes, there is the mainframe-software vendors' experience in dealing with large data-base-management systems that gives them an edge in an important part of the software market: the micro-to-mainframe link.

"The big advantage for mainframe software companies [is that] they already have a big sales force in place and a customer base," says Michael Stone, senior analyst with Future Computing. These mainframe-software firms are "a proven commodity" for large corporations, he adds. **–Robert J. Kozma**

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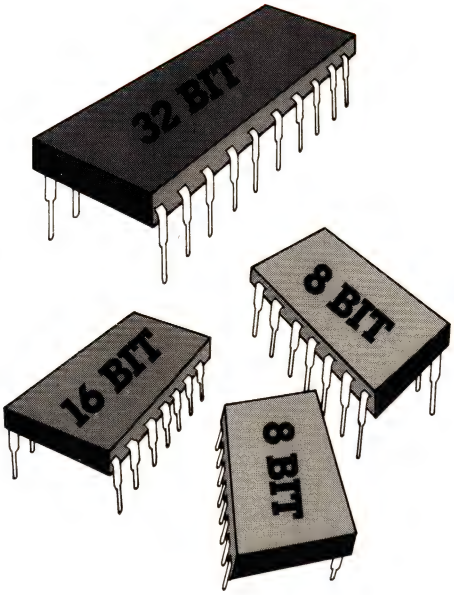

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tations they want to uphold.

These software houses may well be the spark needed to push the entire microcomputer-software industry toward a higher level of support. As the industry matures, they point out, one of the most important ways in which users will distinguish among vendors will be their reputations for service and support.

About a quarter of the market is composed of large corporate customers, the mainframe-software vendors' traditional customers (see "Juicy market whets suppliers' appetite," p. 52). However, these vendors are also after the smaller customer.

Take Management Science America Inc., of Atlanta. It has been selling software for Apple and IBM personal computers through its Peachtree Software subsidiary for about a year and has just announced 25 new products, some of which run on Atari and Commodore low-end home computers.

Service the key. For programs retailing for as little as $95, Peachtree offers a toll-free phone number with people answering calls during business hours; calls cost the user nothing for the first 90 days. Beyond that, support costs about $175 per year for packages selling for $600 and is also available at a fee of $25 per hour without an extended-support agreement.

More than 20 people work full time answering Peachtree's phone lines, and the number is expected to be well over 30 by the end of the year. Despite experience with Apple and IBM PC users, executive vice president Dennis Vohs admits that "the real question is in the Atari and Commodore market, where the user may have no support from his dealer. We are untested in this area.

"The big key is to train dealers," says Vohs, because such problem cases have a tendency to disappear when dealer support is available. The company provides this with a training force that travels around the country, and it is also considering using its mainframe education centers for evening classes in the running of microcomputer sofware. Some 25% to 30% of the sales income from such software will go to fund customer-support programs, Vohs estimates.

ITSoftware Inc., of Princeton, N. J., which spun off after Martin Marietta Data Systems purchased parent Mathematica Inc. last year, sells microcomputer software through retail channels. The IT-series programs are sold directly to corporate accounts by Martin Marietta and the Mathematica Products Group, a major vendor of mainframe data-base software. But for end users who are not serviced through these corporate accounts, ITSoftware "is a full-service organization," says Edward Zimmerman, product manager.

A free hour. ITSoftware offers one hour of free phone consultation to users who return their license-agreement cards and says it will charge $40 per hour thereafter. Metered charges do not include time involving program bugs, only time spent answering how-to questions.

Cullinet Software, of Westwood, Mass., intends to make a clear distinction between corporate and other end users of its microcomputer software, drawing the line at a level of approximately 25 purchased licenses of a product. The phone support planned for noncorporate users may not be the 24-hour service offered to corporate accounts, but there are no strict limits on the time available to any one user. **–Jeremy L. Young**

Unix spreading to low-end users

Unix is now for everybody—at least that is what some 30 vendors of small-business computers running the popular operating system from AT&T Bell Laboratories are saying. Low-end Unix systems for one to eight users are proliferating.

The latest entry, the Miniframe from high-flying Convergent Technologies Inc., follows the successful Megaframe introduced a year ago, and means that the Santa Clara, Calif., outfit is also jumping into the Unix market in a big way. In addition to the new hardware, which the company says has the lowest cost per user of any Unix system yet available (less than $1,250), Convergent has announced extensive application support—both in-house development efforts and third-party agreements.

The scarcity of business-application and personal-productivity software has been a stumbling block in the sales of low-end Unix systems to the small-business market. This is still the problem, according to consultant Amy Wohl of Advanced Office Concepts, of Bala Cynwyd, Pa. What is needed, she adds, is a marriage between software developers and Unix hardware houses. "That is what Convergent and Altos Computer Systems are trying to promote," says Wohl.

Both Convergent and Altos, in San Jose, Calif., now have application software from a host of third-party original-equipment manufacturers either available or well on its way. For Convergent, 50 packages are ready, and it is adding 15 more each month.

Convergent has also established its own Unix development program under John Mashey, the father of shell programming, who devised the first Unix shell at Bell Labs. Mashey joined Convergent in April 1983. Under Mashey, Convergent has integrated some of the Berkeley Unix features, such as demand-paged virtual memory, into AT&T System V Unix. Convergent offers the Bell Bourne shell as standard, the Berkeley C shell as an option.

Already there. But Convergent is not the first to enter the Unix commodity market. Altos has been shipping its Series 586 Xenix-based machine, for five to nine users, for two years. It is shipping more than 2,000 a month, accounting for 80% of its revenue. One quarter of its sales are to OEMs, the rest to dealers who sell to small end users.

NCR Corp.'s 68000-based Tower 1632 is also offered in an entry-level system configuration for eight users. Hardware costs $11,495 and includes 512-K bytes of memory, 8 serial ports, a 46-megabyte 5¼-inch Winchester hard disk, power-fail recovery, and diagnostics. Unix Version 7

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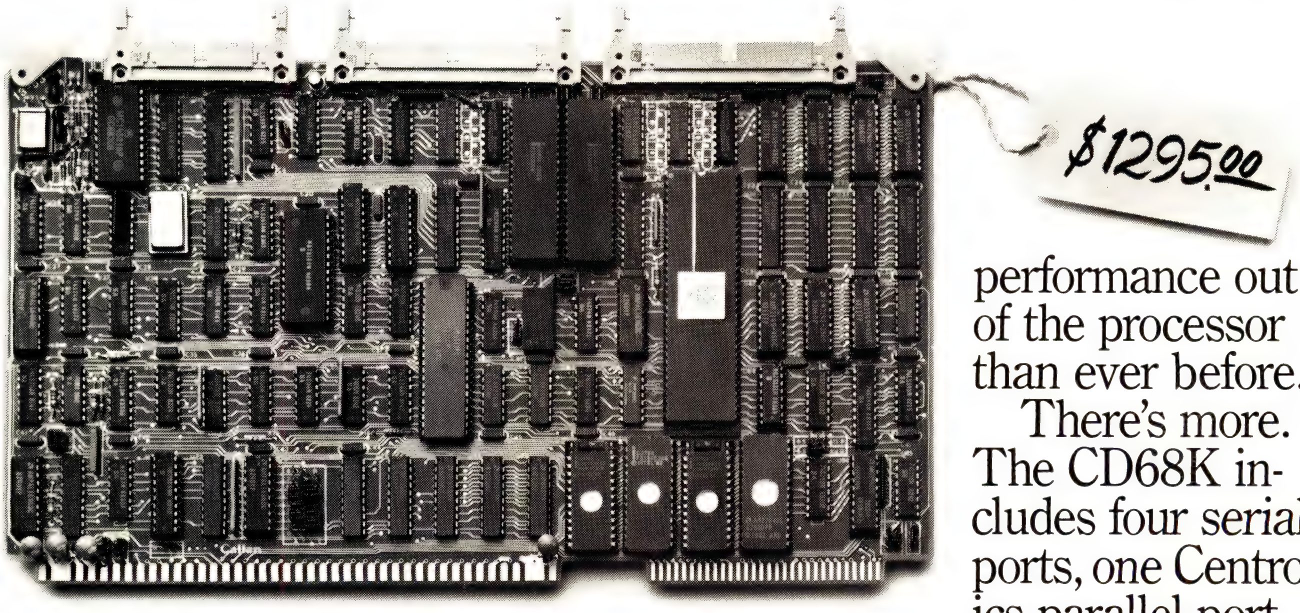

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News briefs

TI to join in developing and making National's 32-bit family
Texas Instruments Inc., of Dallas, and National Semiconductor Corp., of Santa Clara, Calif., have agreed jointly to further develop and produce National's 32-bit family of microprocessors and peripheral support chips. TI president J. Fred Bucy says that the agreement is "not just a second-sourcing arrangement of existing products" but a "pooling of resources" to build a full product line in the 32-bit family, formerly the NS16000 and now the series 32000.

Satellite Business Systems-IBM marketing venture expected soon
Look for Satellite Business Systems, McLean, Va., to market its private networks and public switched services jointly with International Business Machines Corp., Armonk, N. Y., which owns a third of the smaller company. Stephen B. Schwartz, the new president of SBS, says his firm's success depends on its ability to raise its 1% market share to 4% by 1990.

U. S.-Japanese production and marketing pacts go both ways
NEC Corp. has signed a five-year second-source agreement with Zilog Inc. under which the Campbell, Calif., firm will produce NEC's complementary-MOS 16- and 32-bit microprocessors [*Electronics*, Jan. 26, p. 67]. The first samples are expected out by year end. In June, the Japanese firm will start shipping samples of its 8-bit 70108C and 16-bit 70116C microprocessors.

In another agreement between U. S. and Japanese semiconductor makers, Intel Corp. has licensed Oki Electric Industry Co. and its American subsidiary, Oki Semiconductor, of Santa Clara, Calif., to market C-MOS versions of the 8086 and 8088 microprocessors. Oki designed the chips, which have on-board dynamic random-access memories, and has been using them internally for a year; however, it needed Intel's blessing to use the 8086 microcode. The agreement also covers peripheral chips and the 8085 processor, but not the advanced 80186 and 80286.

Storage Technology postpones laser-disk production after loss
Caught in an earnings slump, Storage Technology Corp., of Louisville, Colo., has delayed volume production of its laser-based optical-disk storage system until the first quarter of 1985. Only a month ago, officials were still hoping to meet the firm's $100 million sales goal in 1984 [*Electronics*, April 19, p. 32]. But Storage Technology's business picture soured as older tape units became less profitable and the cost of product introductions climbed. In the quarter ended March 30, the firm's after-tax loss was $16.7 million, on sales of $179.5 million, compared with last year's $1.1 million profit on sales of $219.9 million.

with Berkeley enhancements runs on the system and costs an additional $1,500.

Daniel J. Kiegler, manager of the OEM Systems division of the Dayton, Ohio, company, says that "from a philosophical standpoint, we plan to migrate through the 68000 family." This means later Towers may show up using the 68010, followed by 68020. Kiegler says he sees minicomputer makers' moving toward smaller systems as supermicroprocessors head higher and attack markets currently considered mini or low-end superminicomputer territory.

The recently introduced 3B2/300 computer from American Telephone & Telegraph Co., New York, the low end of AT&T's new product line, will support from one to 18 users for a basic price of $9,950. It is compact and quiet enough for a desk. AT&T, mindful, too, of the need for application software—especially at the low end—has an agreement with Digital Research Inc. of Pacific Grove, Calif., to produce Unix applications for both companies to market. AT&T Technologies' Thomas Crowley, software systems vice president, says that out of this close relationship, AT&T will have its first packages this year.

–**Clifford Barney**
and Wesley R. Iversen

Systems integration

Network, PBX legions prepare for battle

History repeats itself, the adage goes. So when two conferences in New York—on the same dates and only a couple of blocks apart—started to stake their claims to the office of the future, it was like Rome and Carthage eyeballing each other across the sea, getting ready to fight to the death for control of the world.

At the Conference on PBX Strategy, hosted by S&R Consultants Ltd. of Madison, N. J., the private-branch-exchange community was told to coexist with the traditonal data-processing side of the house—but to gird itself with the fourth-generation switch with distributed intelligence just in case.

At the same time, speakers at the Networking of Personal Computers Conference, sponsored by Frost & Sullivan Inc., of New York, were saying that the proliferation of local nets may have done more harm than good. They stressed the need to standardize around inexpensive, easy-to-use communications channels—but cast baleful glances at PBX solutions.

W. Spencer Rice, senior partner at S&R, sees a fourth-generation PBX as a digital switch integrating PBX and local-net features on wideband communication channels. With intelligence, it will offer word processing, digital facsimile, and electronic mail. When manufacturers "redesign the switch using fiber optics in the backplane [to increase switching speeds] with general-purpose processors, the PBX and local net will be the same," he said.

Among makers of fourth-generation systems, Harris Corp.'s digital telephone division, Novato, Calif., is beta-testing its 20/20 system for third-quarter shipment. CXC Corp. in

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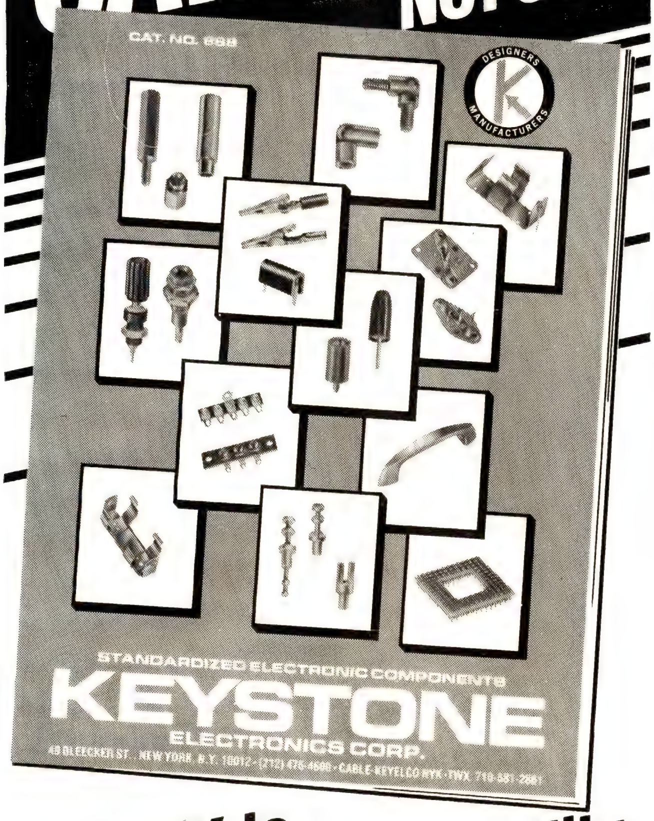
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Irvine, Calif., is developing the Rose—expected to begin shipping in midyear—and in Wilmington, Mass., Ztel Inc.'s Private Network Exchange is being prepared for the market in the fourth quarter.

Meanwhile, speakers at the network conference called for inexpensive methods of sharing office hardware and software resources. Ivan Frisch, president of information products at Contel Information Systems Inc., Great Neck, N. Y., conceded that if PBX manufacturers keep pushing the frontiers it will become impossible to distinguish between the PBX and the local network. But he added that it is going to take PBX manufacturers 10 years to match local nets. –**Robert Rosenberg**

Military

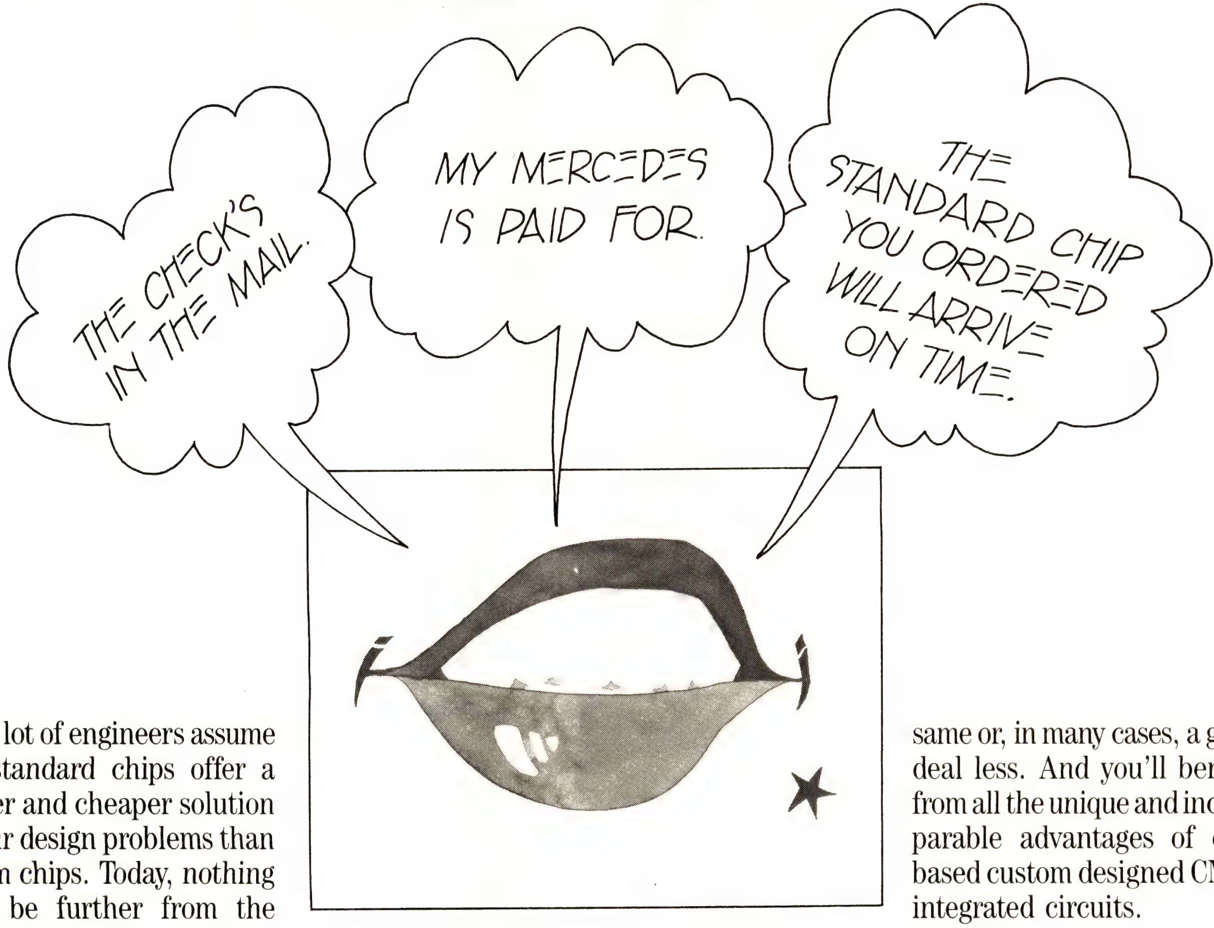
Assent to unreliability must go, says official

The Air Force and its suppliers must reject a mind-set that has led the military to "accept the lack of reliability as an inherent given of high-technology weapons systems." So said Gen. James P. Mullins, the head of the Air Force Logistics Command, during an Air Force Association symposium, "Electronics and the Air Force," at Wakefield, Mass. in late April.

"That mind-set, more than anything else, is responsible for our designing and building systems to go fast and high but not to do so reliably for any length of time. And that mind-set, more than anything else, is responsible for the degradation we're seeing in weapon-system readiness and sustainability—and the tremendous number of defense dollars we're now faced with allocating just to keep these systems going," he adds.

Good value. Mullins called on weapons suppliers to set aside the ingrained acceptance of some degree of failure and use available technologies to improve the reliability of U. S. weapons. "The up-front cost of this investment in reliability would be high," Mullins acknowledges, but

The 3 greatest lies: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"the return in future cost savings would stagger the imagination."

For instance, by raising a fighter aircraft's mean time before failure (MTBF) from 500 to 625 hours, Mullins says, "you could reduce the spares requirement almost 40% and still maintain the same aircraft availability." A 1,300-hour MTBF goal for U. S. forces is within reach, he says, tipping his hat to the Navy's 2,000-hour MTBF for the tactical air-navigation system of its F-14 fighter. Far higher MTBF levels are coming, he adds—for instance, the 10,000-hour level the very high-speed integrated circuit (VHSIC) program is expected to bring to the signal processor of the Air Force's F-15s and the 40,000-hour MTBF predicted for the ring laser gyroscope.

The general said that the savings from more reliable weapons go beyond a reduction in logistics. "Given our typical system reliability today," he notes, a commander weighing the prospects of a mission must often send several planes to provide the same assurance of success that one reliable aircraft could.–**Ray Connolly**

Computers

Fault tolerance added by NCR

Fault-tolerant systems, a growing trend in the computer industry, have a new champion: NCR Corp., of Dayton, Ohio. Part of what the company calls its Incremental Architecture is a new hardware-and-software combination that links multiple processors in NCR's V-8500 and V-8600 mainframe family lines.

Thus critical applications will not be shut down by hardware, software, or firmware failures in any one part of the system. The new offering also makes it possible for users to expand their systems economically by allowing up to eight loosely coupled hosts to share access to a common pool of peripherals.

Fault tolerance is included in an enhanced version of the Virtual Resource Executive (VRX) operating

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Circle 62 on reader service card

system, which already runs on NCR mainframes. Unlike systems whose redundant processors run the same applications in lockstep, NCR's lets backup processors work on other jobs, notes Barnhart.

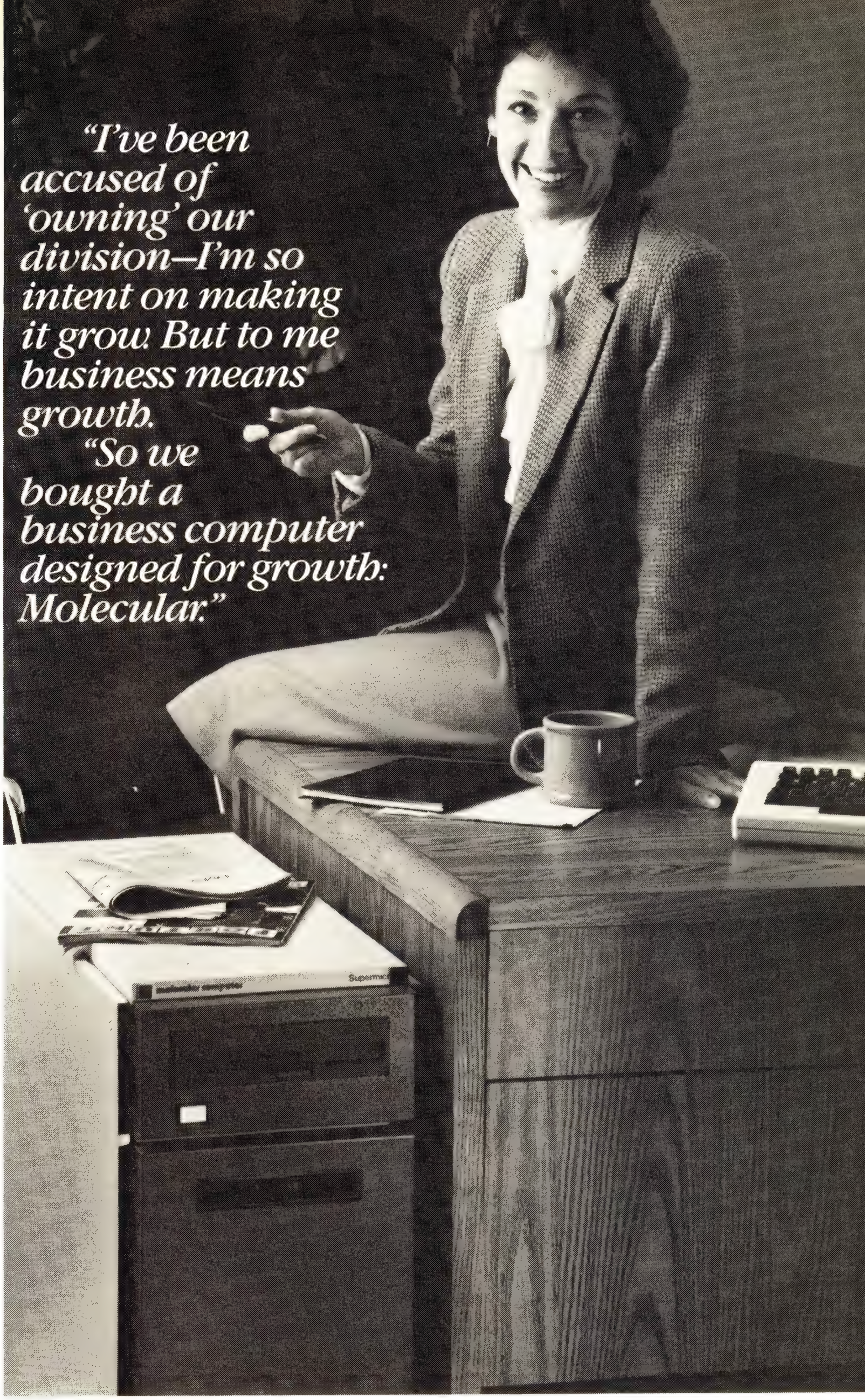
Copies of critical applications running on one processor can be loaded into one or more processors within the loosely coupled system but remain idle as a low-priority task. If a failure occurs, the copies can automatically be activated to take up processing at the exact point of failure, ensuring the data's integrity, the company says.

NCR does not quote recovery times in case of failure, since they vary according to system configuration, failure mode, and the degree of fault tolerance purchased, among other things. The Memphis, Tenn., fire department has used the system since February, and recovery times have amounted to "less than 1 minute in the majority of cases," says Stephen P. Barnhart, NCR's director of V systems product marketing.

Fast enough? That is slower than the 2-second recovery time that fault-tolerant industry leader Tandem Computers Inc., of Cupertino, Calif., claims for its own systems. Nonetheless, Barnhart contends that NCR's Instantready feature is the most advanced now available for automatic recovery on a large mainframe from any of the traditional computer makers, including International Business Machines Corp.

Though new application software can be written to achieve fault tolerance with the new NCR system, users will have to modify existing programs running under old VRX versions to take advantage of Instantready. However, Barnhart says NCR is working on new software tools, which may make it easier to write fault-tolerant software and to modify existing programs.

Excluding the processors, the hardware needed to assemble a typical two-processor fault-tolerant system could cost up to $86,000, with the new software licensed from NCR for $95 per month. Both the software and hardware are available now, NCR says. **–Wesley R. Iversen**



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Washington newsletter

U. S. trade balance in electronic products to turn negative . . .

As imports of components, computers, and telecommunications equipment continue to climb, the U. S. trade balance in electronics will turn negative in 1984. In fact, **the electronics trade balance has been shrinking steadily for the past few years, dropping sharply in 1983, to $1.4 billion, from more than $5 billion the year before.** John A. Calhoun, deputy assistant secretary of the Commerce Department and the head of the newly formed Science and Electronics Group, says that "there is nothing we see that would change these trends in 1984." The job of Calhoun's unit is to support U. S. industry and reverse the deteriorating trade balance. Last year, total electronics imports—including components, computers, consumer products, telecommunications, and test, measurement, and medical instrumentation—rose to $26.5 billion, compared with exports of $27.9 billion, the department reports.

. . . going into red $2 billion or more

Deputy assistant secretary John A. Calhoun of the Commerce Department was not willing to estimate the size of 1984's negative balance, but another official believes it will total from $2 billion to $3 billion. On top of longstanding negative trade balances in consumer electronics and office products, trade in components turned negative in 1982, while trade in telecommunications equipment did so last year, largely as a result of soaring imports from Japan [*Electronics,* May 3, p. 69]. **Trade balances are still positive for computers and instrumentation,** but are shrinking for both, says Calhoun.

Air Force loses bid for communications system over incompatibility . . .

The Air Force has lost its $34.4 million bid to develop the Enhanced Joint Tactical Information Distribution System, known as EJS, in fiscal 1985. The reason: the House Armed Services Committee says that the resultant tactical aircraft communications package would not be interoperable with the JTIDS time-division multiple-access system, **to which the Army, Navy, and North Atlantic Treaty Organization are committed.** While cutting out the EJS program, however, the House committee added $15 million to the Air Force communications research and development budget to immediately begin work on an antijamming JTIDS TDMA system.

. . . as failure to set up joint programs is criticized

The absence of joint programs by the three services to develop interoperable systems in general produced sharp criticism of the Department of Defense by the House Armed Services Committee in early May. As the powerful committee cut proposed fiscal 1985 research and development monies to a real growth level of 8% from the 21% sought in January, it said each of the services is still unable to accept technology developed outside its bailiwick and to undertake joint efforts. Although the Air Force and Army appeared to want to work together to develop a Joint Tactical Missile System and a Joint Surveillance and Target Attack Radar System, **the House committee says it found that each service went its own way.** The criticisms of the Pentagon's apparent inability to coordinate the programs of the services, plus the resultant funding cuts by the House unit, generated much interest in the defense community in view of the committee's longstanding reputation as a strong advocate of military programs.

Washington commentary

Why 'Star Wars' won't fly

Unexpected scenarios pop up regularly in Washington. The latest and most interesting involves President Reagan's Strategic Defense Initiative—or SDI—the so-called Star Wars plan advanced in March 1983 that would deploy antimissile systems in space to identify and destroy enemy missiles launched against the U. S. or its allies.

Many observers initially saw the proposal as a bonanza for the military-industrial-congressional complex. For example, the plan calls for spending $26 billion over the next five years just to determine feasibility. That compares with the $8 billion sought by the space agency to develop, build, and deploy a permanently manned space station within a decade. Considering SDI's magnitude, no one will hazard an estimate on its final cost. It is this economic uncertainty, combined with increasing political opposition to the concept, that is causing supporters in Congress, the military, and industry to take a second look.

It did not take long for the Defense Department's leaders and their analysts to realize that the development of a perfect or near-perfect defense system against Soviet missile attack is, as one congressional study puts it, "so remote that it should not serve as the basis of public expectation or national policy" on missile defense. Not only are the technologies required for SDI's directed-energy weapons not at hand, but no one is able to gauge when such weapons could be built in a laboratory, much less deployed. In any event, SDI's components could never be tested in space as a complete defense system without risking a nuclear attack.

Without a perfect or near-perfect defense against incoming warheads, the U S. would face the prospect of nuclear destruction from a massive strike by the Soviets—the only option left to them by the SDI.

Questions in Congress

As it grapples with a Federal budget deficit of more than $200 billion for fiscal 1985, Congress is more than ordinarily concerned about the state of the economy in this election year. Even the Senate Armed Services Committee's Sam Nunn (D., Ga.), a staunch defense advocate, finds it difficult to accept the Reagan rationale for SDI in view of the program's fuzzy goals. Similarly, the House Armed Services Committee contends that the Pentagon lacks "a comprehensive development plan" for the program, and has cut $407 million out of the $1.776 billion request to start the SDI feasibility study in fiscal 1985.

For the military and its contractors, the SDI effort looms as a serious threat to a variety of programs in various stages of development in a budget that has little room for further growth. Most military electronics and aerospace contractors' views are summarized by one company's Washington counsel, who observes, "I can't speak for quotation, of course, because a space-based missile defense sounds a little too romantic to be real at this point. And, frankly, we like things pretty much as they are when it comes to weapons spending."

Although such remarks might be read as favoring the status quo, they also indicate a realistic evaluation of defense spending options. Some Washington officials see a commitment to SDI as potentially threatening in terms of concentrating too much money in too few places. They see space defense research and development draining DOD resources as the development of the Space Shuttle drained the National Aeronautics and Space Administration of funds that were needed for other efforts.

Professional military men and their technology deputies give lip service to the SDI concept, of course. Scheduled to retire in June, Air Force Systems Command chief Robert T. Marsh speaks openly, saying that "current and past C^3I challenges aren't even in the same league" with SDI, whose demands on command, control, communication, and intelligence technologies will require "a quantum leap forward." Gen. Marsh notes only that "we are in the very early stages of this effort and don't yet know all of the technical challenges facing us." Like his subordinates and their contractors, the general is more comfortable dealing with the seemingly solvable problems of developing a small, mobile intercontinental missile with a single warhead like the newly authorized Midgetman, or coming up with a Precision Location Strike System to find and attack an enemy's command and control ground installations.

The reasons why generals, congressmen, and leaders in the technology community stand shy of the SDI initiative may vary substantially, although the end result is the same: a presidential proposal destined to be starved with limited R&D monies and no true support. It is better that way.

–Ray Connolly

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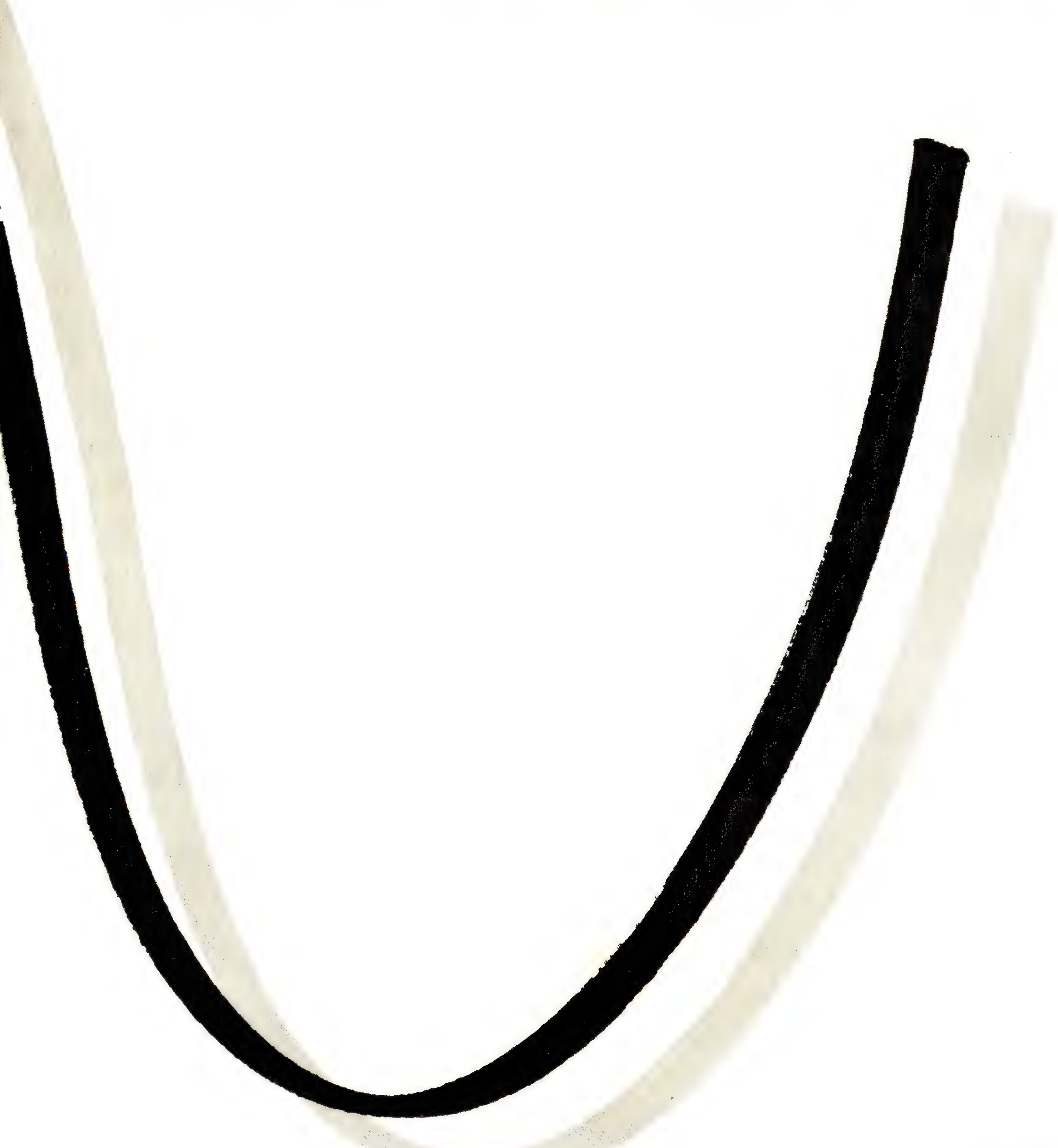

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International newsletter

France goes cable after long delay

After a protracted delay, the French cabinet has approved the introduction of cable TV over the next few years. French Post and Telecommunications Minister Louis Mexandeau says that to bring cable into 160,000 homes by next year using fiber-optic technology, the government will make an initial investment of some $120 million—to be split between the Compagnie Générale de Constructions Téléphoniques, a now-nationalized former ITT subsidiary, and CIT-Alcatel. According to Mexandeau, **the cable network will use all-domestic equipment unless France reaches reciprocal agreements with European neighbors** to allow French suppliers into their markets. France could now cable 200,000 homes a year, a figure Mexandeau says could double by the end of 1985.

UK patches together a joint venture for satellite broadcasting

The British government—now resigned to the fact that it will not see the early payback it expected two years ago from direct broadcasting by satellite—is taking a new tack to introduce the service into the country: it is clearing away the last legal hurdles with its cable and broadcasting bill, now before Parliament. The government has always insisted that broadcasting from space should pay its way, but prospects were pretty much destroyed when the British Broadcasting Corp. hedged on acting on its license to operate two DBS channels from a British-made satellite that industry would provide. The Independent Broadcasting Authority, the commercial sector of British broadcasting, would have taken added channels at a later date. The government has now concluded that **the best hope of introducing satellite broadcasting into the UK is to bring all potential participants together in a single company,** and the new bill would permit that to happen. It proposes that the BBC take a half share, while the IBA and other interested organizations divide the remainder.

Convolvers are extremely fast

Exploiting their expertise in surface-wave technology, experts at the Central Research Laboratories of Munich-based Siemens AG have developed convolvers with **pulse widths up to 17 μs correlated over a device length of about 6 centimeters.** Low-loss acoustic focusing elements allow a convolution efficiency (the ratio of output power to the product of all input power components) of -62 dBm. Integrated thin-film networks match the input and the output to 50-Ω lines, thereby achieving a convolution uniformity of ±0.4 dB in amount and ±5° in phase. Echoes are suppressed by better than 40 dB. Applications for these convolvers include the extremely fast analog-signal correlation that must be performed in pattern-recognition and video-processing equipment.

NTT triples buys of U. S products

Nippon Telegraph & Telephone Public Corp. is making good on its pledge to buy more from U. S. firms, tripling its purchases last year over 1982. It has placed a $12 million order with Cray Research Inc. for a supercomputer, the X-MP system. NTT wants it to help with designing very large-scale ICs and with recognition processing in character and picture research at its Electrical Communications Laboratory in Yokosuka. **Also, NTT will soon order Unix software to run the $49 million Advanced Traffic Observation and Management Information Collecting System** that the Japanese firm recently bought from American Telephone & Telegraph Co. Consisting of AT&T's 3B20S minicomputers, it avoids congestion in telephone toll network traffic by providing automatic circuit-switching. These purchases bring NTT's fiscal 1983 purchases of U. S. gear to $133 million; 1982's total was $38 million.

Brazil seeks AT&T's Unix

Representatives of Brazil's government and private industry are visiting American Telephone & Telegraph Co. to negotiate a license for AT&T Bell Laboratories' Unix operating system. At present, all personal computers built in Brazil run under CP/M, which is proving to be insufficient for the needs of automated office systems. **The discussion will not go smoothly, however, as the two industry associations involved are at loggerheads.** The Brazilian Association of Computer and Peripheral Manufacturers seeks to coordinate the entry of Unix through a consortium of manufacturing companies interested in building it into their machines, while the Brazilian Association of Data-Processing Service Companies wants one of its members, Brasil Informatica e Tecnologia Ltda. (BIT), to acquire the license system and be solely responsible for commercializing Unix in Brazil.

AT&T wants BIT to get the contract, says company director James Tompkins, one reason being that BIT "defended AT&T's interests last year, when other Brazilian companies tried to market a pirated version of Unix." BIT lobbied against the spurious version and was instrumental in keeping it off the market. The U. S. company is also working with BIT in a joint venture with Brazil's largest TV network for a 10-year franchise covering telephone-directory services.

Future looks cloudy for Italy's Zanussi

The future of Italy's second-largest private industrial firm, the electronics and appliance producer Zanussi SpA of Pordenone, is still in limbo. **Negotiations for Swedish producer Electrolux to participate in the cash-hungry company have been scotched by pressure from labor unions,** which fear that a foreign partner or majority shareholder would slash job levels by more than the 5,000 to which they have already agreed. Under union pressure, Italy's Industry Ministry is attempting to gather a pool of private Italian companies to invest in the troubled company but is having difficulty. Most of Zanussi's competitors have increased market share at its expense. The firm desperately needs an estimated $156 million in fresh capital, a figure the majority shareholder, the Zanussi family, cannot meet. To complicate matters, the Friuli region, where Zanussi is located, is witholding a promised $47 million in financing unless it is assured that corporate control will stay in Italy.

Addenda

Thomson SA, the chronically ailing nationalized French electronics giant, **expects to move into the black sometime during the second half of this year and show an outright profit for 1985.** Total losses during 1983 were about $150 million, down by almost 50% from 1982 [*Electronics,* May 5, 1983, p. 76], and they included nonrecurring losses resulting from an extensive restructuring program. . . . **Japanese manufacturers of videocassette recorders exported 763,000 units to the U. S. in March, a dramatic increase of 190% over the same month a year ago,** according to Japan's Ministry of Finance. Total Japanese VCR exports in March were 1,572,000, a 46.9% increase over the same month in 1983.

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The NS16081 sets the performance standard for floating point operation.

Binary floating point computations are performed to 32-bit (single) and 64-bit (double) precision. The NS16081 conforms to the IEEE format for binary floating point arithmetic. This assures you the safety of precision, conformity, and compatibility.

The powerful NS16000™ floating point architecture, and its efficient implementation in the NS16081, can achieve system performance greater than any other microprocessor-based system (see accompanying chart). No operation exceeds 12μs at 10MHz.

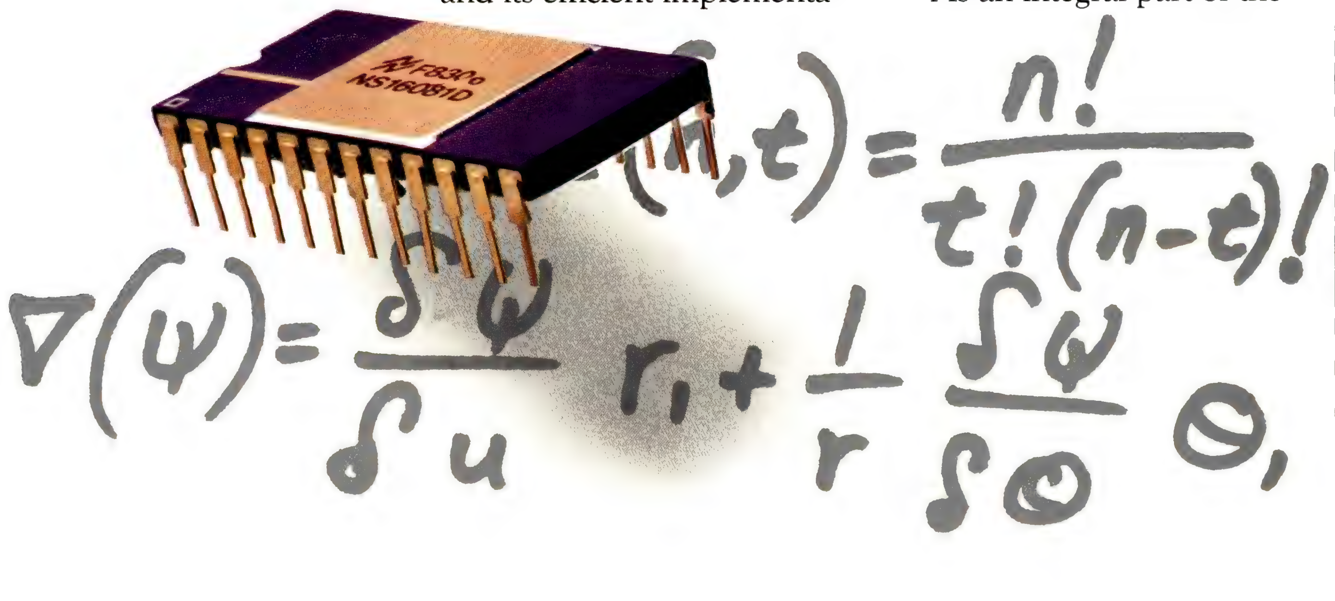
Imagine how the NS16081 can enhance *your* system performance.

In a comparison test running a 1024-point Fast Fourier Transform program, and the Whetstone Benchmark, an NS16032/NS16081 system ran 5 times as fast as the 68000, and even out-performed VAX.™ On the Whetstone Benchmark, this system ran 16.7 times as fast as the 68000, and came close to the speed of the VAX.

NS16000 floating point architecture offers code efficiency.

Optimal code efficiency results from the symmetrical instruction set and the powerful addressing modes of the NS16000 family architecture.

As an integral part of the



NS16000 family, the FPU inherits this elegance.

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FLOATING POINT PERFORMANCE COMPARISON

Execution Time

SYSTEM	FFT	WHETSTONE
NS16000 family[1] (10MHz)	3.0s	4.3s
68000 + ROM[2] (10MHz)	15.0s	72.0s
VAX-11/750[3]	4.0s	4.0s

1. Difference in execution times from previously published numbers is a result of improved numerical algorithms in the Pascal library.
2. 68000 floating point implemented in standard ROM-based software Motorola provides no floating point hardware to-date.
3. Without floating point accelerator.

REGISTER TO REGISTER ADDRESSING MODES

NS16081 (10MHz)

FUNCTION	SINGLE PRECISION	DOUBLE PRECISION
Add	7.4μs	7.4μs
Subtract	7.4μs	7.4μs
Multiply	4.8μs	6.2μs
Divide	8.9μs	11.9μs

Note: These timings are based on an NS16032/16081 system. They measure the entire instruction time, including communication overhead and worst-case normalization in a system with no WAIT states.

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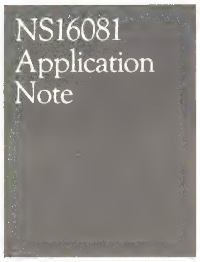
Read about it.

For more information, request The NS16081 Application Note which describes how to design the FPU into 68000 systems.


NS16081
Application
Note

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MICROCOMPUTER SYSTEMS DIVISION

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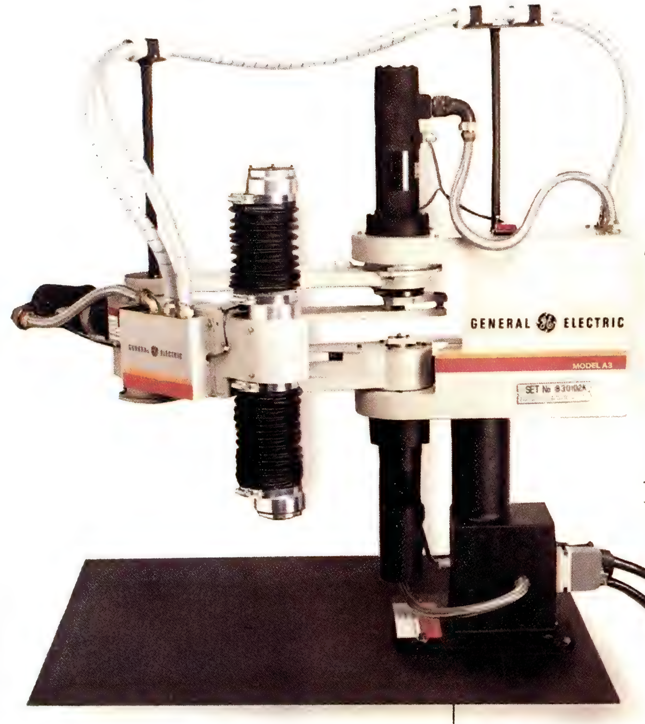
Moving righ



Look how one of the smallest industrial robots—the new GE A/3 assembly robot—can handle one job after another. This lightweight, versatile robot is a cost-effective solution to more different batch and process applications than there are days of the week. For example:

Monday: Palletizing

With a reach of 700 mm and a top speed of 59 in./sec., the GE A/3 can palletize 300 crates of these selector switches within two hours.

Time to program: easily under one hour. The reason: a built-in shift function that allows for fast programming of palletizing applications.

Tuesday Morning: Materials Handling

The reach and speed of the A/3 make it a good choice for most light materials handling jobs. And the large working envelope of 8.62 square feet within a safety area of only 48 square feet, means the A/3 can easily fit into most of your current manufacturing areas without rearranging your shop.

Tuesday Afternoon: Inspection/Qualification

The A/3 is engineered for use with vision systems for inspection and qualification. An interrupt function can alert the robot to break off from a taught program should quality parameters or safety guidelines be exceeded.

Wednesday: Parts Loading/ Unloading

The A/3 can also be used for parts loading/ unloading. Programming is quick and easy because of the A/3 user-friendly control unit with a 16-bit microprocessor and magnetic bubble memory.

There are a multitude of loading/unloading jobs the A/3 can handle. You have 508 program steps available (with an additional 512 steps available as an option) and up to 1000 steps per job.

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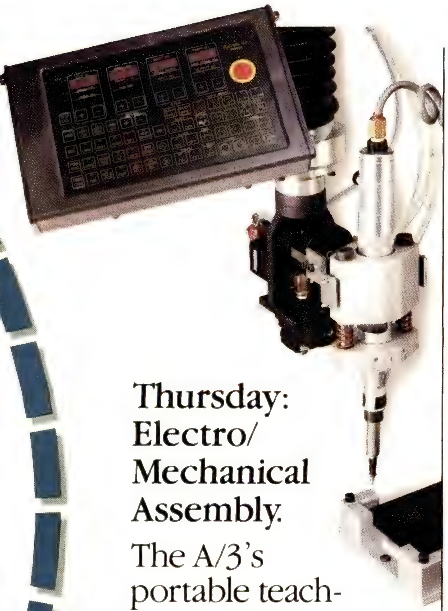
long....



Thursday: Electro/ Mechanical Assembly.

The A/3's portable teach-box is engineered to accept program data without extensive interaction between control unit and work piece. So programming is quicker and easier. This makes the A/3 an excellent choice for nanufacturers of small, aried lots.

These robots are already ised in assembly of disc drives, VCRs, electrical fans, umps, motors and the like.

Another advantage: the A/3 has the capability to per-orm a number of functions at one work station. It can select one or more screwdrivers, drills, sealant applicators, or arious other tools from a ack and perform a series of equential tasks.

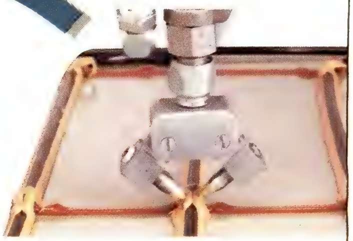
Friday: PC Board Stuffing

As low cost and versatile as the A/3 is, it is also one of the few robots with a programmable Z axis. This will allow the delicate higher precision assembly that many manufactured products need today.

Combined with a vision sensor and a repeatability of ±.002 in., you're ready to handle just about any odd shaped component that PC board manufacturers need inserted.

Saturday: Sealant/Adhesive Joining

The ability to use detachable solderers and adhesive dispensers, plus the capability for circular interpolation, gives you the edge over most other bonding alternatives.



Want More?

A fourth (twist) axis is available as an option. If you need increased payload, the A/40 can handle jobs up to 22 lbs.

These three robots offer practical low-cost solutions to many manufacturing problems. For your more complex automation challenges, GE has a full line of robots, and the experience to design effective solutions.

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Coherent fiber optics taps potential for unlimited bandwidth

by Kevin Smith, Senior Editor

In order to use the spectrum more efficiently, heterodyne and frequency-multiplexing are being exploited

Present-day fiber-optic communications systems work by directly modulating and detecting the intensity of the laser light, a technique that has much in common with the spark-gap transmitter Hertz used to demonstrate the existence of electromagnetic waves. Although simple and convenient, direct modulation and detection scarcely begin to tap optical fiber's enormous communications bandwidth. More advanced techniques *that* exploit the laser's high spectral purity are now on the way, with British Telecom's Martlesham Research Laboratory, near Ipswich, among the front-runners.

As in modern broadcasting and telephony, these coherent communications systems can modulate the phase, frequency, and intensity of the laser transmitter. This means that researchers can start exploiting more than half a century's experience in using the frequency spectrum more efficiently.

Well packed. Using heterodyne and frequency-multiplexing techniques that are well proven in broadcasting and microwave technology, it is now in theory possible to pack more than 1 million TV channels into a single optical fiber, using an optical window with a wavelength of 1.25 to 1.6 micrometers.

British Telecom first demonstrated the feasibility of coherent fiber-optic communications in an award-winning paper presented at the Eighth European Conference on Optical Communication, in 1982. Since then, Japan, the U. S., and the UK have been racing to develop a practical coherent communications system. Martlesham has now passed two more milestones in the long road to tap fiber optics' virtually limitless communications capacity.

Martlesham has demonstrated a phase-shift-keyed (PSK) homodyne-detection fiber-optic receiver—in theory, the most sensitive kind of fiber-optic link. Such a transmission system could be teamed with a simple optical repeater, making it possible to envisage an all-optical transatlantic submarine link.

These experiments used bulky heli-

Pure and simple

Solid-state lasers whose spectral purity is several million times greater than that of the laser diodes now used in operational systems will be needed to make coherent communications systems practical. More immediately, such lasers can also be used to advantage in today's direct-detection systems: for the same data rate, the range between repeaters can be extended; with the same repeater spacing, the data rate can be increased.

The reason is that the dispersion (or pulse spreading) generated as a light signal propagates down a fiber is absent when the laser diode operates at a single frequency. Gas lasers do emit at a single frequency, but their solid-state counterparts nominally operate at a 1.52-micrometer wavelength, support several lasing modes, and have a fine-tooth-comb spectrum. The common aim of Japanese, British, and U. S. research is to suppress all but a single longitudinal mode by using distributed-feedback or split-cavity lasers.

British Telecom's latest effort, fabricated by a mixture of liquid-phase-epitaxial and metal-organic chemical-vapor deposition, is a ridge laser operating at 1.47 μm. (A second version operates at 1.52 μm.) A corrugated wafer surface holds the key to the laser's high spectral purity. These corrugations form an interference, or diffraction, grating in the lasing cavity's walls, reflecting laser light back into the cavity and suppressing all but a single longitudinal lasing mode. With a pitch of less than 1 μm, the corrugations are formed by extremely advanced electron-beam lithographic techniques.

The ridge structure's virtue is its ability to eliminate unwanted capacitance, so that the laser diode can be driven at data rates up to 1 gigahertz. Using direct rather than coherent detection, the diode has already transmitted data at 565 megabauds over 100 kilometers without a repeater. Because attenuation is lower in the 1.52-μm optical window, British Telecom expects to transmit 1 gigabit of data across 100 km using its 1.52-μm ridge diode. Even now, this diode's spectral line width of 0.25 nanometers—equivalent to a bandwidth of 10 megahertz—is pure enough for some coherent communications. But if an external cavity some 15 centimeters long is added, the diode's line width can be further tuned to 10 kilohertz. **–K.S.**

um-neon lasers. But in a more recent development, British Telecom has now produced a laser diode with a spectral purity of just 10 kilohertz, equivalent to 10^{-7} nanometers—10 million times purer than the diodes now used in operational fiber-optic systems (see "Pure and simple," p. 81).

Twins. In the PSK homodyne system, both the transmitter and the local oscillators operate at identical frequencies and in a precise phase relationship. The PSK difference signal is extracted at the detector when the incoming and the local oscillator signals are mixed.

Like heterodyne detection, in which the transmitter and local oscillators operate at different frequencies, the process produces effective gain and can be used to overcome the following electronic amplifier's thermal noise, thus improving sensitivity. In addition, the receiver selectivity permits the use of frequency-division-multiplexing techniques like those in conventional broadcasting and telephony.

Of the two techniques, a PSK heterodyne technique is easier to implement. British Telecom first used it, in 1983, to transmit data at 140 megabits a second, with a wavelength of 1.52 μm, over a 109-kilometer fiber link. Sensitivity was 25 times better than direct-detection systems can achieve. The attraction of heterodyning, says John Midwinter, British Telecom's head of fiber research, is that the receiver is tunable. "Using the local oscillator we have on the bench, we could tune over a bandwidth of 7 gigahertz. That's vastly more than we can conceive of using at the moment, though one possibility is to use such a bandwidth in a passive switching setup. At the receiver, equipment would merely tune in to the selected channels."

Most recently, British Telecom researchers have demonstrated a complete homodyne-detection system in the laboratory. A 140-Mb/s PSK signal was transmitted over 30 km of cable in a setup that used a balanced optical phase-locked-loop receiver. Both the transmitter and detector used helium-neon lasers operating at a 1.52-μm wavelength. The transmitter diode worked into a lithium niobate waveguide phase modulator.

In the receiver, the transmission link's output polarization was compensated to match that of the local oscillator, and the two signals were fed to the balanced optical phase-locked loop.

Components

Miniature components carved from silicon may be used as mircosensors and valves

The processes and techniques that have spawned highly complex circuits with micrometer dimensions on tiny silicon chips are bringing back mechanical parts, but in a new form—as miniature components carved out of silicon. West Germany's Fraunhofer Institute for Solid State Technology has done pioneering work in the young field of micromechanics.

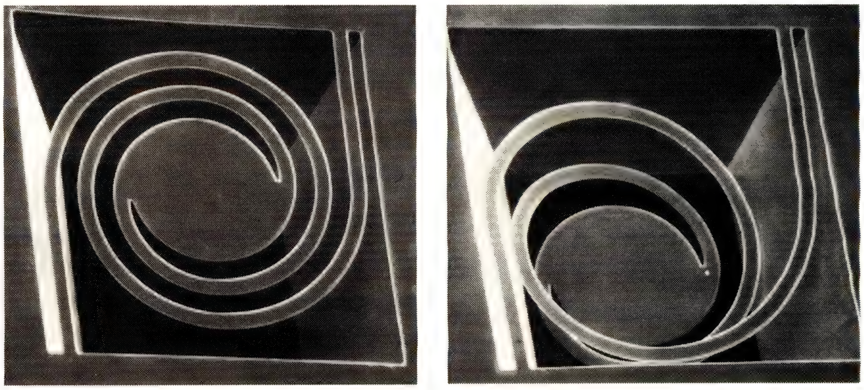
This Munich-based research establishment believes that the potential of siliconized mechanical parts is so vast that it is setting up a department for microstructure technology, in West Berlin. Institute officials believe that the new department will probably be the very first in the world to undertake extensive research into the behavior of tiny mechanical silicon structures using X-ray lithography techniques, among other things. In the U. S., International Business Machines Corp. and Texas Instruments Inc. have also carried on work in micromechanics but with different approaches.

Micromechanical parts are modeled out of thin silicon foils by suitable etching techniques, such as those based on potassium hydroxide or ethylene-diamine-water mixtures; they are often three-dimensional, the third dimension being the depth of the foil. They can be relatively simple devices, such as miniaturized sensors for detecting force, pressure, or acceleration, or they can be membranes for picking up sound.

Other examples are rods suspended at either one or both ends and used for determining vibration, shock, and temperature, or for flow measurements. When coated with a special layer of hygroscopic polymer, the rods can also detect moisture by virtue of the change in their lengths or degree of bending.

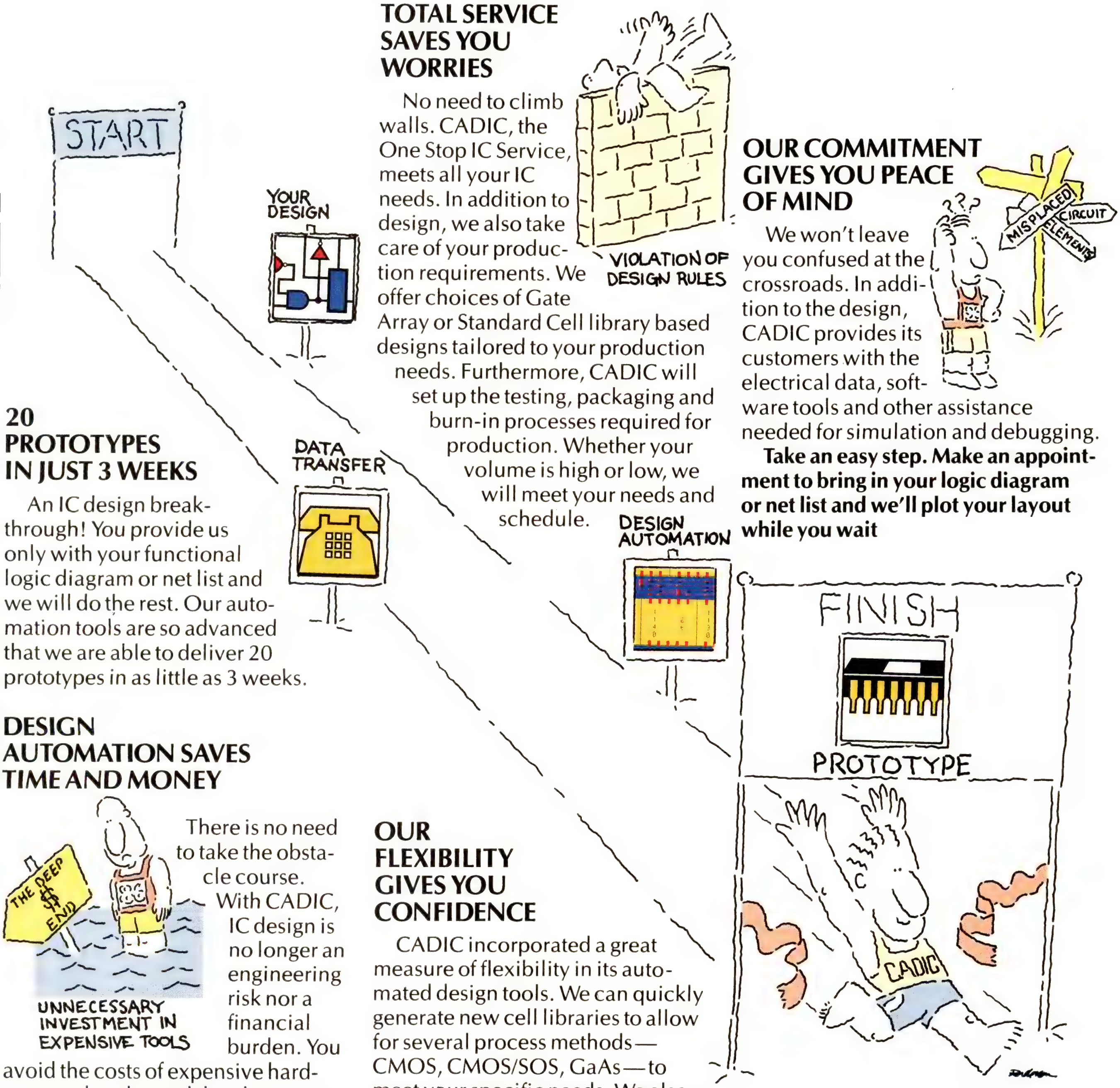
Although the structures of these devices are many times larger than those that can be achieved with the fine-line technologies used in chip production, they are nonetheless far more precise than ordinary mechanical parts are.

Micromechanical devices have two big advantages over their convention-



Good vibes. A spiral-shaped gas or vibration sensor is shown left in quiescent state, at right deflected. The downward deflection is a maximum of 300 micrometers. This device can also be used as a microvalve when operated by precise electronic or thermal control.

CADIC CLEARS THE TRACK TO CUSTOM IC DESIGN



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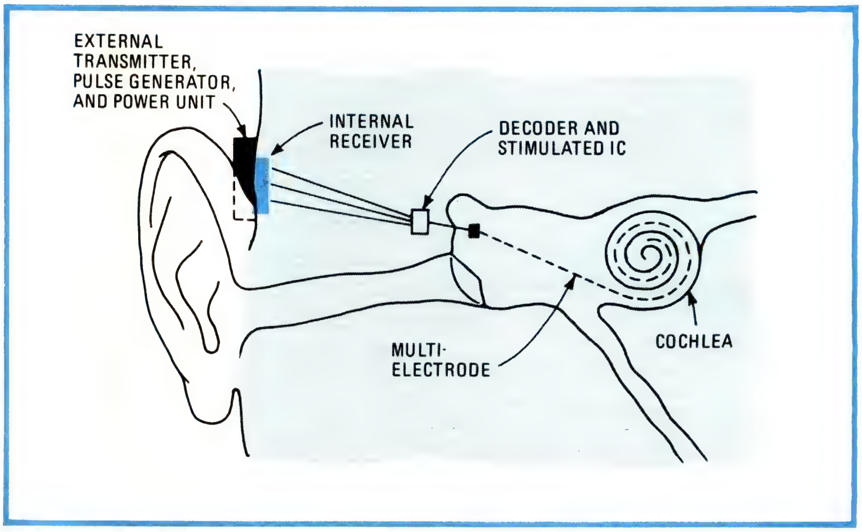
al counterparts, the institute says. For one thing, they are inexpensive because very well-established techniques for producing chips have made volume production possible. For another, they can be integrated with electronic components on the same chip. This, for example, allows a membrane that deflects as a result of pressure to work on the same chip in conjunction with the electronic circuitry that translates the deflection into measured data. Inexpensive micromechanical devices whose output is electronics-compatible should greatly expand the use of microelectronics in measurement and control.

Derivative work. The work, which is supported by West Germany's Ministry for Research and Technology, draws heavily on the results that the institute has so far achieved in X-ray lithography. An essential step is the anisotropic selective-etching process, which is well suited for 3-d structuring of silicon. Highly doped stop layers eliminate the need to control and monitor the etching processes precisely. This way, mechanical structures such as membranes and rods can be modeled into the silicon crystal.

In addition, the institute has developed a vibration sensor that can also be used as a microvalve. In these applications, two spiraling crystal arms, a few micrometers wide, hold a plate elastically over a small discharge hole, with the plate opening and closing the hole. In the present sample, the plate, which deflects downward by as much as 300 micrometers, responds to gas pressure. It is also possible, however, to operate the plate by precise electronic or thermal control. –**John Gosch**

Medical

IC stimulation aids inner-ear disorders


EXTERNAL TRANSMITTER, PULSE GENERATOR, AND POWER UNIT
INTERNAL RECEIVER
DECODER AND STIMULATED IC
MULTI-ELECTRODE
COCHLEA

New hope. An IC implanted at the base of the cochlea that uses electrodes to directly stimulate auditory nerves eliminates an external computer common to most other approaches. Hearing pulses and power are transmitted across the skin by inductive link, avoiding infections.

Medical treatments for hearing defects have progressed remarkably in the last decade. But people with disorders of the cochlea, the inner ear's snail-shaped canal, which contains the essential organs of sound, are still without an effective treatment, much less a cure. Now a team of microelectronics researchers at the Katholieke Universiteit, Leuven, Belgium, has united an original integrated circuit with an extremely clever sensor-and-transmission configuration. The result may well soon provide at least a rudimentary solution to this most common of hearing defects—perhaps the last one for which no surgical treatment exists.

In the strictest sense, the scheme is not a cure, because it bypasses rather than rectifies the problem. In normal hearing, acoustical signals are transconducted into neural signals by the cochlea's hair cells. When these cells are destroyed, the inner ear can no longer function. Engineers at the university have devised a way of picking up acoustical signals from outside the body, translating them into electrical pulses, and then transmitting them to the inner ear, where they are decoded and used to stimulate the auditory nerves directly. Unlike other systems being developed in which the user must wear an outside speech processor and power supply, this unit is entirely self-contained.

Of course, such systems can never completely replace the natural mechanism, with its almost infinite variations of aural shade and color, particularly in such esthetic experiences as music. However, the university researchers do believe that their technique could let patients understand normal conversation. Those who have heard in the past could quickly use the device; others would have to be taught to hear.

The system comprises four parts: a package (skin-mounted behind the ear) containing an acoustic sensor, a pulse generator, a transmitter, and a power source; a receiver planted in the mastoid bone; an IC to decode the generated pulses; and an electrode to stimulate the auditory nerves. The last three parts are implanted surgically. Once implemented, the system's only external manifestation is a small package, about the size of a shirt button, behind the ear.

Inductive. In the external package, a programmable pulse generator converts data from a speech-decoding sensor into a series of pulses that modulate a 20-megahertz carrier. An inductively coupled link transmits this signal through the skin to the receiver, where it is demodulated. Power is transmitted by the same means at 180 kilohertz and regulated to a stable voltage of 10 volts by the receiver. These inductive links avoid the need for wiring through the skin and any consequent sensitivity to infections.

From the receiver, one of three

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Circle 86 for Literature
Circle 87 for Demonstration

wires transmits the demodulated signal to the IC at the entrance to the cochlea; the two other wires carry supply voltage and mass, respectively. The IC converts serial information from the receiver into stimulation currents for eight bipolar electrodes, which take the form of a single multi-electrode implanted in the cochlea, where it can reach the auditory nerve fibers.

Because the response frequency of the colchea decreases in a progressive manner toward its point, or apical turn, the multielectrode is shifted in the cochlea in order to exploit this topological structure by stimulating a distinct group of nerve fibers that correspond to a distinct frequency band. The system's basis is the integrated circuit. Realized in the university's own 3-micrometer n-channel MOS technology, it receives input information consisting of pulses with variable height and width.

The width determines the stimulation current's amplitude, while the height indicates the electrode for which the pulse is intended, so any electrode can be selected at any time. During the input pulse, the width is converted into a corresponding voltage, and the height is detected and decoded. The circuit then drives the corresponding electrode.

The Katholieke Universiteit researchers say that the eight channels provide enough frequency spectrum to transmit speech and that first results on patients are encouraging. Their next step will be to study further the relationship between the injected charge and neural activity by using the IC's inherent ability to carry out neural measurements. They will then make use of this information in order to optimize stimulation patterns. **–Robert T. Gallagher**

Solid state

Standard C-MOS devices can operate as lateral bipolar transistors

Thanks to a clever design twist from a Swiss microelectronics research center, anyone using a standard bulk complementary-MOS integrated-circuit process can now fabricate both C-MOS and bipolar devices on the same chip. This development should be particularly welcome to designers of analog ICs, since bipolar transistors, with their greater ease of control, are still more attractive than MOS ones.

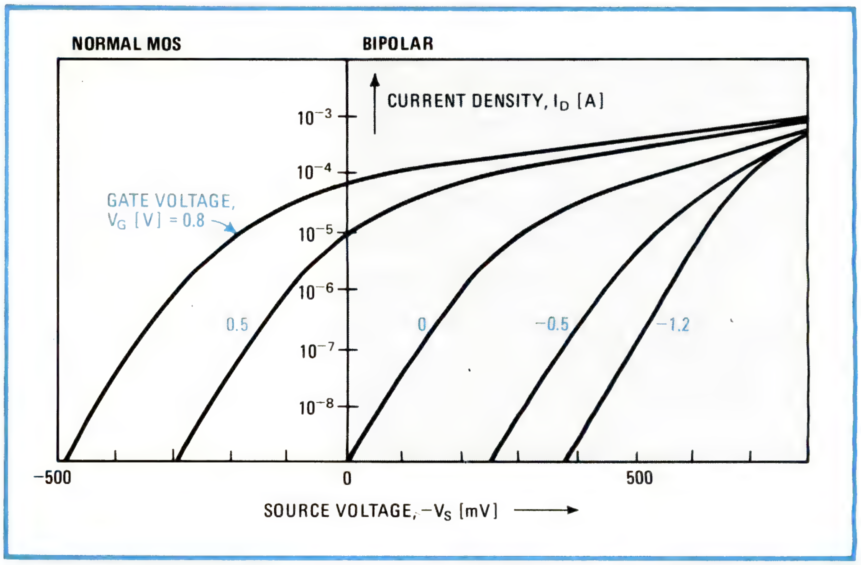
With a few special—and usually expensive—exceptions, the standard approach of MOS designers who need bipolar transistors has been vertical transistors using the substrate as the collector and a separate well as the base. The problem is that the unavoidably fixed collector potential limits this technique strictly to common-collector configurations.

Engineers at the Centre Electronique Horloger SA, in Neuchâtel, have discovered that a much more powerful device is available in any bulk C-MOS technology just by operating MOS transistors as lateral bipolar transistors. Eric Vittoz, one of the company's vice directors, discovered the technique while working with the laboratory's 6-micrometer, low-voltage, silicon-gate C-MOS technology. He points out that typical MOS operation is obtained for positive gate-voltage values.

Zero and small negative values also create MOS characteristics when a negative source-voltage value forward-biases the source-well junction. At sufficiently large negative gate-voltage values, however, source-to-drain conduction is pushed below the surface of the device and pure bipolar operation is achieved (see figure).

Vittoz explains that he was able to anticipate this behavior from the structural similarity of MOS and lateral bipolar transistors but was surprised by the bipolar operation's high quality, confirmed by a high gain. This gain he attributes to a reverse-biased well-substrate junction.

It is not necessary to modify standard C-MOS processes to achieve such operation. However, the lateral bipolar transistor structure can be optimized if the emitter area and the lateral base width are minimized and the emitter is surrounded by the collector—steps that increase the collector-source current ratio. So far, says Centre Electronique Horloger, it has has realized accurate current mirrors, low-noise amplifiers, as well as bandgap-voltage references with the technique. **–R. T. G.**



Schizophrenic. As gate voltage moves from positive to negative for this standard MOS transistor, operation changes progressively from MOS to bipolar. At gate voltage of −1.2 volts or more, the device achieves pure lateral bipolar transistor operation.

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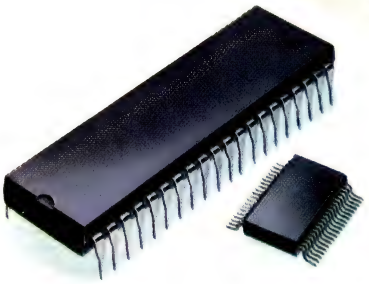

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68000	●	●	●
68010	●	●	●
Z80	●	●	●
NSC800	●	●	●
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Behrendt casts global eye on his young computer firm

Sven Behrendt wanders between two worlds. As president both of Force Computers Inc., in Santa Clara, Calif., and of Force Computers GmbH, in Munich, West Germany, this ocean-hopping executive spends about equal time in both places.

Simultaneously overseeing two operations may not be easy, the 43-year-old Behrendt concedes, but in the long term it will pay off. "We want to become a global enterprise, serving the world market with our products," he says.

Since January and June, respectively, of last year, when the German and U. S. operations started up, they have been working on VMEbus computer boards. The boards are developed and tested at the Munich facility, assembled by a nearby subcontractor, and marketed by the German and Silicon Valley facilities. Next year, the boards will be developed and manufactured in Santa Clara, too.

Although still young, the company already has the No. 2 spot, behind Motorola Inc., in sales of VMEbus boards, claiming 20% to 25% of the total market. Behrendt attributes the firm's success to what he regards as the best price-performance ratio for such boards and the widest product range. If Force Computers keeps on performing in this way, it might indeed become a major factor in the multinational arena before long. Sales are expected to leap from $8 million last year to around $20 million this year, to $50 million in 1985, and to perhaps $100 million in 1988.

Born in Berlin, Behrendt attended school in Israel. In 1959, he returned to Germany, where in 1965 he received a master's degree in physics from Munich's Technical University. Since then, he has worked his way up to executive positions at a number of U. S. semiconductor firms operating in Europe. He prides himself on having started Force Computers without venture capital. "That makes us independent," he says.

Behrendt thinks he will spend more time in the U. S. once the market there for VMEbus boards surpasses Europe's. One third of this year's global sales will come from the U. S., two thirds from Europe. The Old World dominates because the VMEbus concept was first developed in Europe. But the concept is spreading, and next year the U. S. will account for about 55% of a worldwide market that may well reach $100 million.

Happy wanderer. Sven Behrendt seeks to establish his dual-nationality Force Computers Inc. as a world-class producer.

Nuzillat seeks ways of tying research closer to operations

Gérard Nuzillat deserves his honors. In 1974, when he was hired to start Thomson-CSF's activity in gallium arsenide integrated-circuit research—an event that coincided with Hewlett-Packard Co.'s announcement of the first GaAs logic gate—few semiconductor fields seemed as risky. His reward for accepting that challenge and for turning the company's Central Research Laboratory into one of the world's most advanced and respected centers of GaAs IC research was his recent appointment as managing director of the lab, which is located in the Paris suburb of Corbeville.

Nuzillat received his doctorate in solid-state physics at the University of Paris-Orsay and taught there until he joined Thomson. He regards his new position as a very definite role within the nationalized French giant. "Research at Thomson is very decentralized, most of it taking place within the divisions themselves," he explains. "We have to provide an efficient service to those divisions and be best known as a tool that is at the disposal of the group."

Besides III-V semiconductor components, Nuzillat says the other research areas currently important to the lab are optoelectronic components; nonsemiconductor optical components, including optical subassemblies; and displays, both for flat-panel liquid-crystal screens and for projection techniques.

"We try to take the broadest possible approach to research, and our philosophy requires that we have a critical mass of effort for each of the areas we're involved in," Nuzillat says. "I sometimes think of the laboratory as a tree, with basic research in areas like physics and chemistry at the roots. The trunk consists of general means derived from these and are common to all areas that branch out toward applications."

One of Nuzillat's preoccupations may not be strictly technological. Although France has an excellent reputation for the quality of its research, the transfer of technology from laboratories to operating divisions is often deficient. Nuzillat sees this as a "problem of dialog and structure of the interface" between research and development activities, and he feels he is already beginning to improve things.

Taking over. Gérard Nuzillat wants to assure efficient technology transfer from Thomson-CSF's Central Research Laboratory to its operating divisions.

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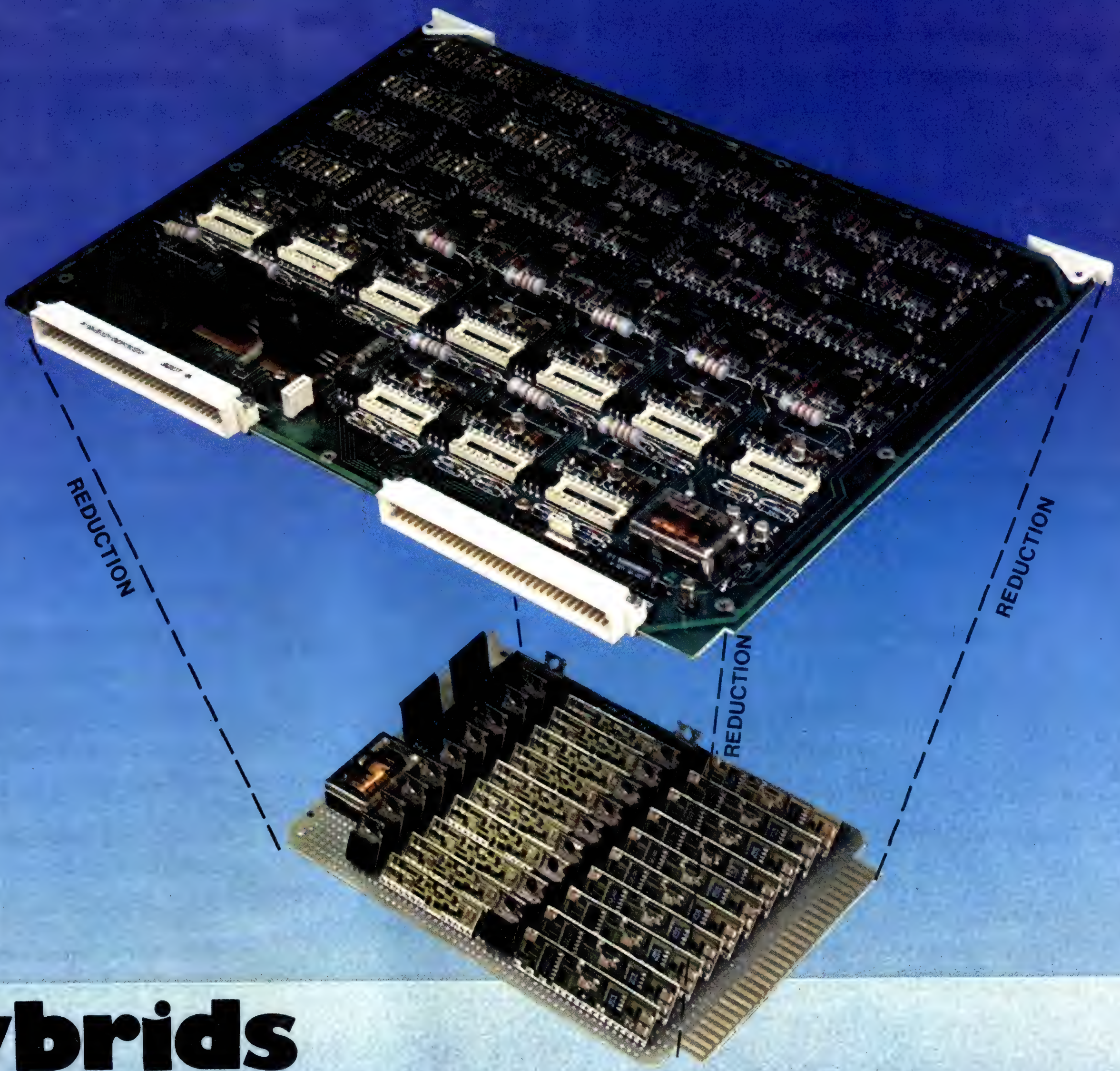

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Graphics system draws 200,000 short vectors in 1 s

by Michael Berger, McGraw-Hill World News

Raster-scan display does fast 3-d modeling thanks to a pipelined architecture that employs eight custom chips

The ever-widening use of computer-graphics work stations for a range of design tasks has created an equally growing need for greater speed and flexibility. Tokyo's Seillac Co. is now readying a system that it claims has the world's fastest raster-scan display. Shown for the first time this week at Computer Graphics 84—the National Computer Graphics Association's annual show in Anaheim, Calif.—the Seillac-7 produces two- and three-dimensional modeling or viewing transformations at writing speeds of 200,000 short vectors/s, short vectors being 2 to 3 mm long. Such a speed is roughly 10 times as fast as other graphics systems that are competing with the Seillac-7 in the under-$30,000 price range.

The system from the young Tokyo company includes eight types of custom-made chips that contain built-in functions to reduce dependence on the host computer. Its speed in 3-d coordinate transformations is attained by busing the function generator, matrix multiplier, clipping and perspective circuits, and polygon-filling unit in a pipelined architecture that employs two 16-bit microprocessors, two 16- and one 32-bit bit-slice processors, and a 4-by-4 matrix multiplier.

The clipping circuit contains a 56-bit multiplication and division processor that detects and eliminates parts of lines that extend outside the boundaries of the specified window area at speeds of 2 to 3 μs for one point and 3 to 4 μs for two points. The same processor is also used for perspective transformations at speeds of about 5 μs/vector. Total computation time for 3-d parallel projection for matrix calculation and clipping is 3 to 5 μs/vector.

The filling processor transmits vectors in the screen coordinate system from the clipping unit to the digital differential analyzer, calculates the intersecting points of the polygon edges, and then fills the interior of the polygon with the specified color pattern.

Other processing within the pipelined-architecture section can be performed at a maximum speed of 1.2 μs/vector and at an average speed of 4 μs/vector. For certain functions such as the filling of a rectangle, Seillac claims a processing speed of 0.7 μs/vector.

Four layers. Tsuneo Ikedo, the company's 38-year-old president, says the powerful hardware his engineers developed also made it possible to design a four-layer hierarchical data structure with a standard 512-K memory, expandable to a maximum of 8 Mb, thus permitting many diversified interactive operations such as rubber-banding, scaling, dragging, and positioning.

An optional software package called Citrus, also designed by Seillac, is based on the Core level 3C standard package, with such expanded functions as transformation, polygon filling, geometric modeling, and graphing. The software is priced from $1,000 to $5,000, depending upon the number of functions desired. The Seillac-7's emulator protocol is compatible with either the IBM/370 or Tektronix 4000 series.

Ikedo, a former computer-aided-design engineer at Seiko Denshi Kogyo, says that the Seillac-7 also generates smooth, high-quality lines—comparable to those of random-stroke displays—by using a concept he calls "look-ahead," which modulates the brightness of intermediate points. This is achieved by using 2-bit data to automatically compute compensatory brightness in accordance with line slopes, thus reducing the conventional "staircasing effect" to a minimum. This function also has a 3-d option thanks to custom-developed emitter-coupled logic that permits processing speeds of 36 ns/picture element.

Seillac, which opened a U. S. affiliate in Carson, Calif., last fall, offers the display monitor in screen sizes of 19 and 24 in. with a raster-scan design featuring a resolution of 1,400 by 1,024 pixels and a standard palette of 64 colors, which can be increased to 16.7 million shadings with the use of the Citrus software package plus an optional Z-axis digital data analyzer that allows a writing speed of 36 ns/pixel.

"We think we have proved the reliability of our system with 48 continuous hours of tests at a temperature of 25°C, and 24 hours' continuous testing at 40°C, with no breakdowns," says Ikedo.

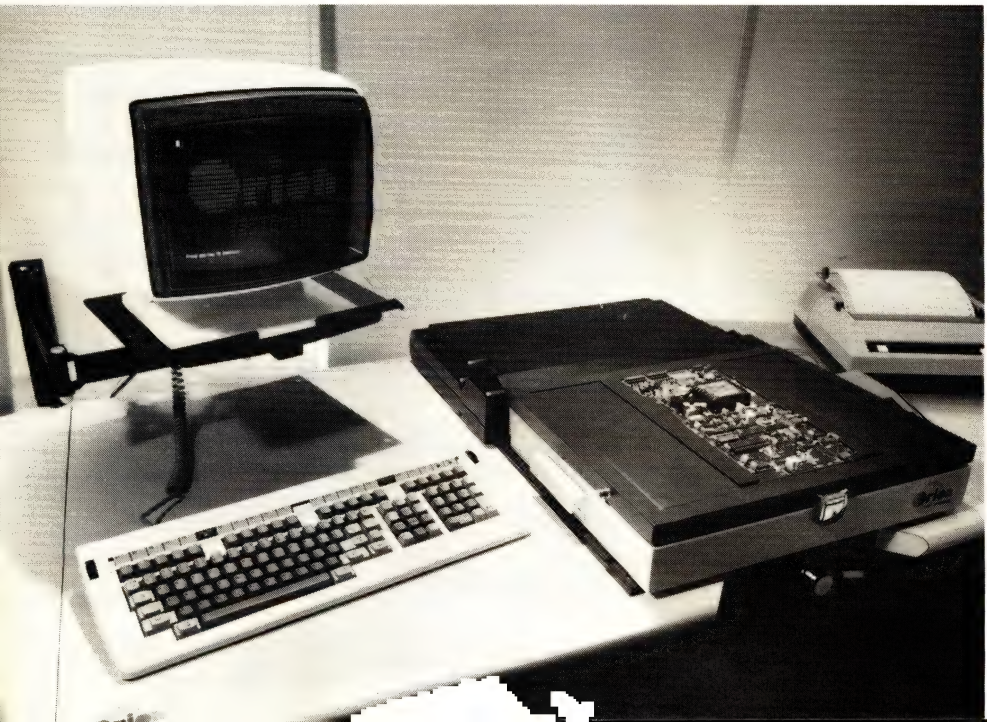
The Seillac-7 is priced at $28,000, with delivery within three months from order. Peripheral devices include a dial-control unit for scaling, rotating, and translating images for 3-d coordinate transformations (for $2,500), a liquid-crystal-display switch that controls 32 functions ($2,000), and color shading that provides depth cueing for wire-frame models and smooth shading for surface and solid ones ($4,000).

Seillac Co. Ltd., Ginza Ohno Bldg., 1-17, Tsukiji 4-Chome, Chuo-Ku, Tokyo 104, Japan
[Circle reader service number 441]

Filling midrange, ATE line serves users making up to 45,000 pc boards a year

Although Marconi Avionics Ltd., in Rochester, Kent, UK, has one of Europe's most experienced automatic-test-equipment divisions, with more than 600 employees and 23 years of experience, it is only now producing a test system designed specifically for the commercial market.

Until now, Marconi Avionics has concentrated on its defense business, and observers might therefore have expected that the company's new Orion series ATE testers would be top-of-the-line no-expense-spared models. Actually, Orion has been targeted at prospective customers manufacturing up to 45,000 printed-circuit boards a year. In this market, the company judged, there was a performance gap between existing midrange ATE systems and more capable but also more expensive units, such as the big system 80 in-circuit tester that a sister company, Marconi Instruments Ltd., sells to very high-volume manufacturers.



The Orion line comprises seven machines, ranging in price from $62,550, for the model 2210, to about $130,000, for the model 6,660. The first two systems in the family—the Orion 2210 in-circuit tester and the Orion 6620 digital-functional in-circuit tester—were launched on May 1 at the Electronics Production Efficiency Exposition, in Birmingham, England.

Orion's design philosophy is to cut a manufacturer's overall test costs by mustering the right mix of bare-board, component, functional and in-circuit testing functions. The company now uses a simulation program called Economic Simulator of Cost in a Production Environment (Escape) to advise customers on the best test strategies. The program can take into account more than 50 variables, such as wage rates, throughputs, average number of faults per board, test times, rework times, ATE programming times, and so forth. It also permits users to compare different test strategies. The system is so modular that customers can then put together the most cost-effective package.

A Data General Nova 4C, which stores application programs on 12.5 megabytes of a Winchester disk, handles the hardware of all models in the series. That computer controls all system operations through two data highways. One, a high-speed extension of the computer's bus, controls the analog and the digital test units; the other, an IEEE-488 bus, controls the in-circuit test system and peripheral instrumentation.

The user interface is a cathode-ray-tube display. Other modules in the system include high-speed digital and analog test units and an analog switch unit. The right-hand cabinet bay accommodates all peripheral instrumentation, such as counter-timers, function generators, and digital multimeters.

Each digital test unit can have up

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to 320 channels; with two test units, a system can be configured for a total of 640 channels. Each system can test data at rates of up to 15 MHz. Analog measurements can also be taken on any channel up to a maximum speed of 1 MHz.

For higher speeds and more complex test requirements, the analog test unit takes over. Like its digital counterpart, it is a functional tester that works by applying a known stimulus to the unit under test and checking its response. The digital unit's main function is to route such instruments as function generators, waveform digitizers, counter-timers, and oscilloscopes to the unit under test. It also provides a specialized stimulus-and-response capability using modules of Marconi's own design, including dc stimulus modules, digital-to-synchro converters, clock generators, and digital pulse generators. Reflecting Marconi's own specialized test requirements, there are also test interfaces for the military's 1553B interface, the bus system now standard on military aircraft, and for its commercial equivalent, the Arinc-429.

The third test unit, the analog switch unit, works with a bed of nails to provide in-circuit testing as well. In other words, the unit can check all component values once they have been correctly inserted into the board. But it does not provide the node-forcing capability that is found on more expensive in-circuit testers.

Since all systems in the Orion line use the same modules, software written for one system will run on any of the others. There are four software packages for Orion, and all of them produce programs in a single high-level test language: ATAL, a derivative of Atlas.

The software tool kit comprises several programs. ICT-GEN handles in-circuit test programming and can generate programs at a rate of 100 a day. Pro-Gen works by learning the responses of a "known-good" board to a defined set of test patterns and then comparing them with the response from a board under test. Lasargen takes test patterns automati-

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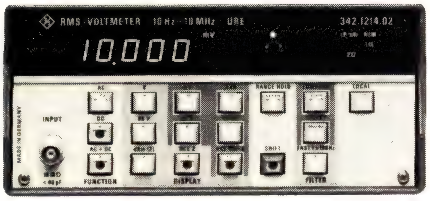

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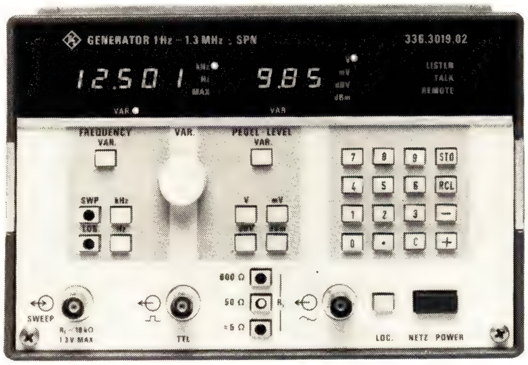

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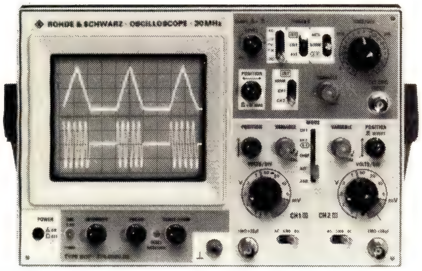

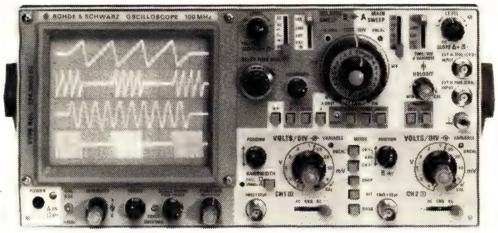

Oscilloscope BOP · DC to 30 MHz (above)
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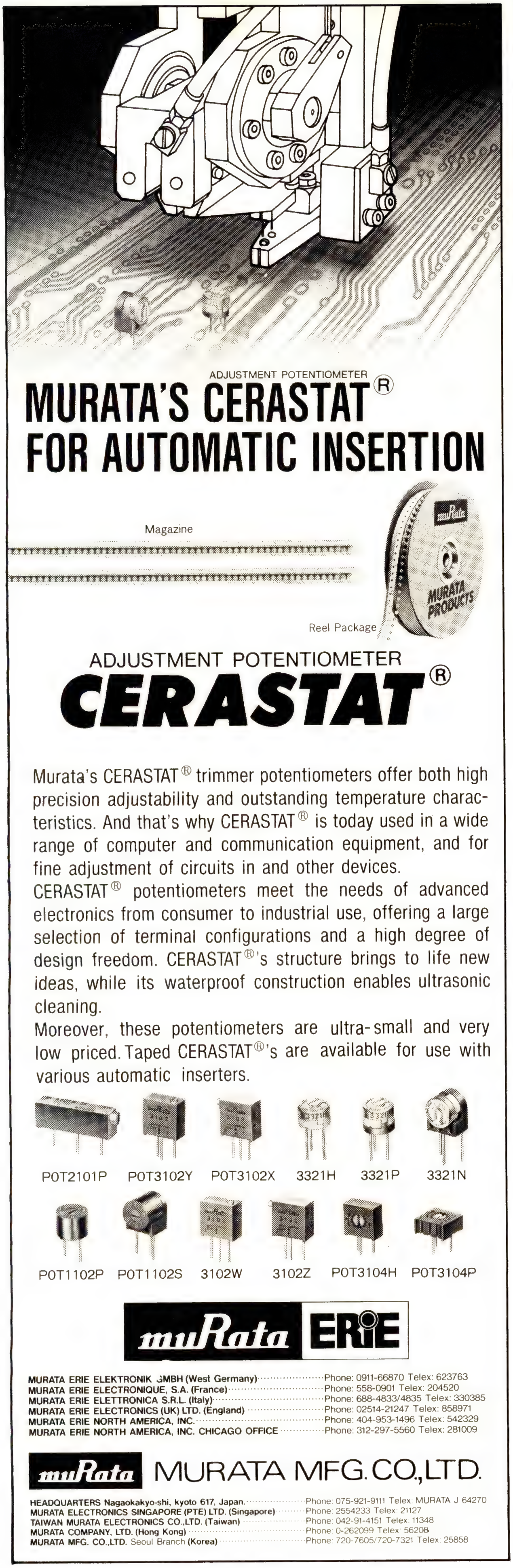

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cally generated by Teradyne Inc.'s Lasar digital simulator, converts them into ATAL programs, and generates a full-fault dictionary to locate faults rapidly. Finally, Mosaic, a conversational prompter for generating ATAL programs, is used for analog functional testing. Once they have been generated, all are compiled into machine code to make them run more quickly.

Marconi Avionics Ltd., Automatic Test Systems Division, Airport Works, Rochester, Kent, England [Circle 442]

Magnetic head alloy is now available in sheet form

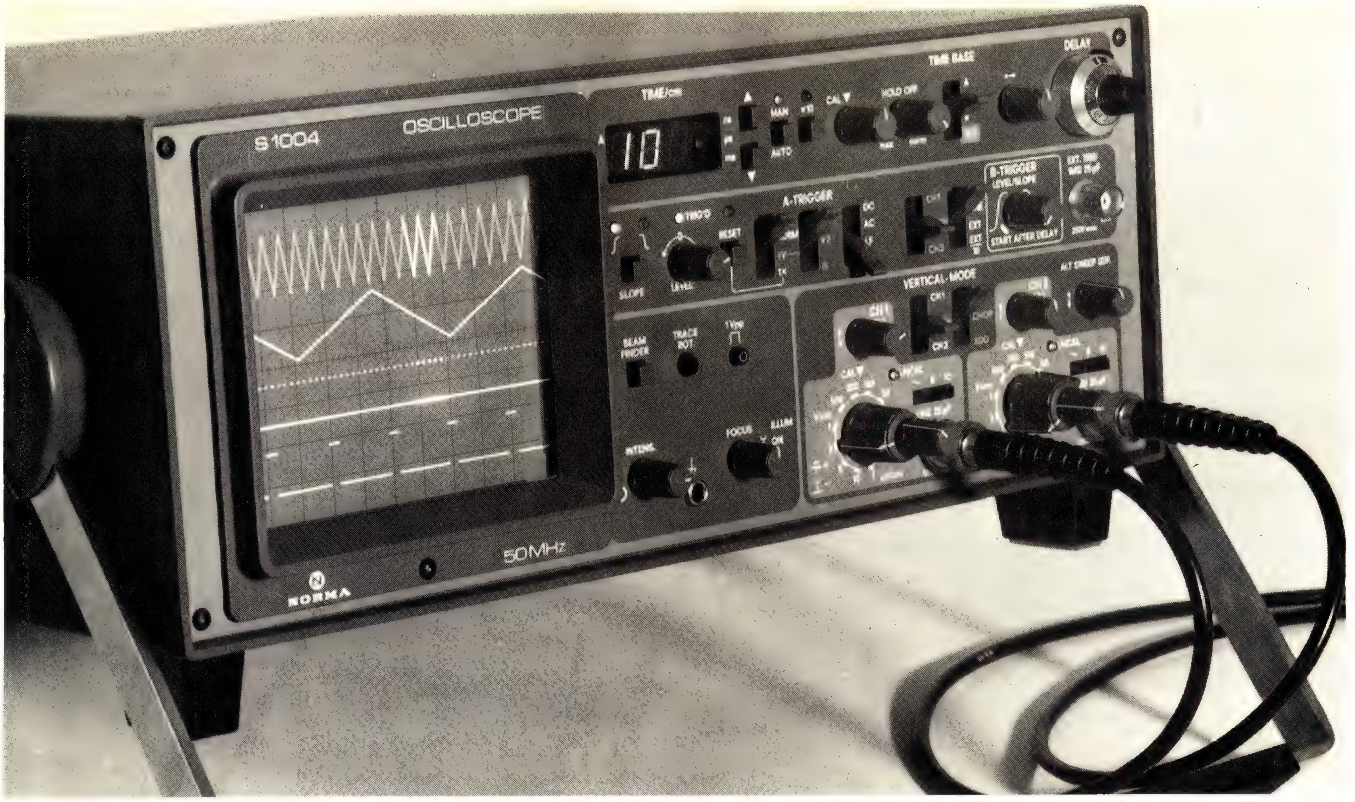
Recovac, the alloy used for magnetic heads, is now available in a sheet form that lends itself to economical production methods. Sheets measure 8 by 16 in. and are 25 or 50 μm thick. Coated on both sides with a thin layer of insulating material, they have been heat-treated and can be stacked to make up laminated magnetic-head packets with optimum magnetic and mechanical properties.

Magnetic heads made of Recovac, which is a modified nickel-iron alloy, can replace those made of nickel alloy, usually used to produce heads for data-processing equipment. Recovac has good soft-magnetic properties, needed for good recording and play-back behavior, and the high resistance to abrasion that is essential for long head life. Unlike brittle silicon-aluminum-iron alloys, Recovac can be rolled, and therefore may be used to make laminated heads.

Recovac sheets are usually supplied with a slightly negative magnetostriction. Tests show that compressive stress arises when the laminated magnetic heads are glued. As a rule, such stress adversely affects magnetic properties—in particular, permeability, an important characteristic in magnetic heads. But with weak negative magnetostriction, the stress does not have noticeable effects.

The price for 50 sheets of the material is 1,500 DM.

Vacuumschmelze GmbH, Gruner Weg 37, D-6450 Hanau, West Germany [Circle 444]



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Perfect Measuring Technology by NORMA

The new 2-channel 50 MHz Oscilloscope S 1004 is a universal measuring device featuring high sensitivity (2 mV/cm) and a fast timebase (10 ns/cm), suitable for versatile applications in development laboratories, in production and quality control as well as for servicing and educational uses in all areas of electronics.
Superior compactness has been achieved through the use of specially developed assemblies, such as automatic timebase selection, the line selector for TV triggering, a hold-off circuit and a second timebase.

Simple to Operate
These modern electronic circuits have also made it possible to reduce to a minimum the time required for operation. Thus there is no more need for continuous focusing during changes of brightness, this being taken care of by an automatic focusing circuit, while another automatic circuit, independent of signal level, replaces manual setting of the trigger level, and a third one selects the most suitable deflection coefficient, setting the time range and simultaneously displaying three LED digits for the value and unit selected. A beam-finder and two invertible channels are convenient supplementary features.

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Great stress was placed in design on operations under the harsh conditions of servicing work. Long axes of rotation and cable harnesses have been avoided, resulting in high immunity to shocks and vibrations. Use of a low-loss mains section means very low proper heating.
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P-Multimeter D 3745	4½ digits (max. 54000), 5 A, 1000 V, 50 MOhm, computing functions (dB, %, HI-LO limit, 10 memory locations, reference value, relative offset)

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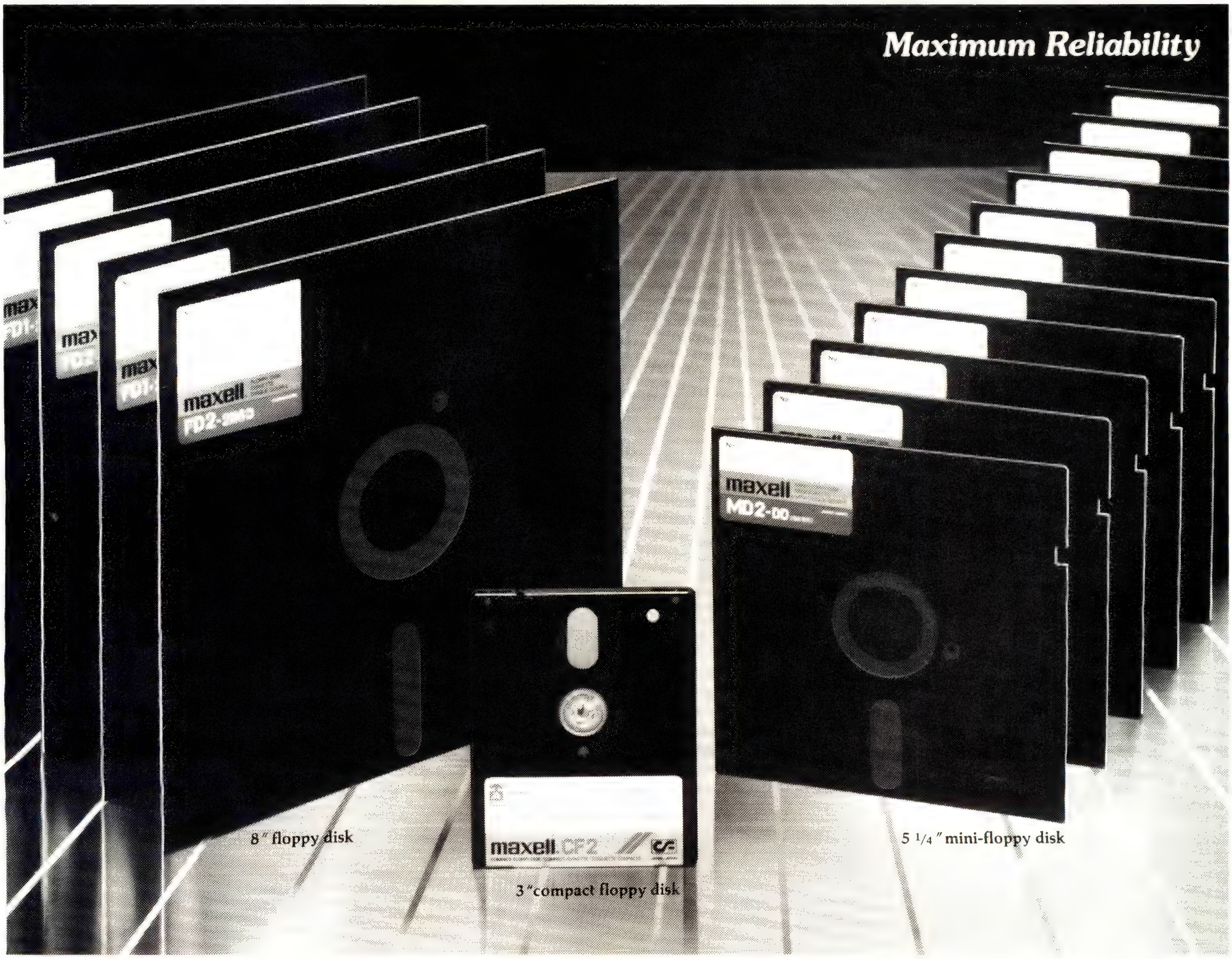

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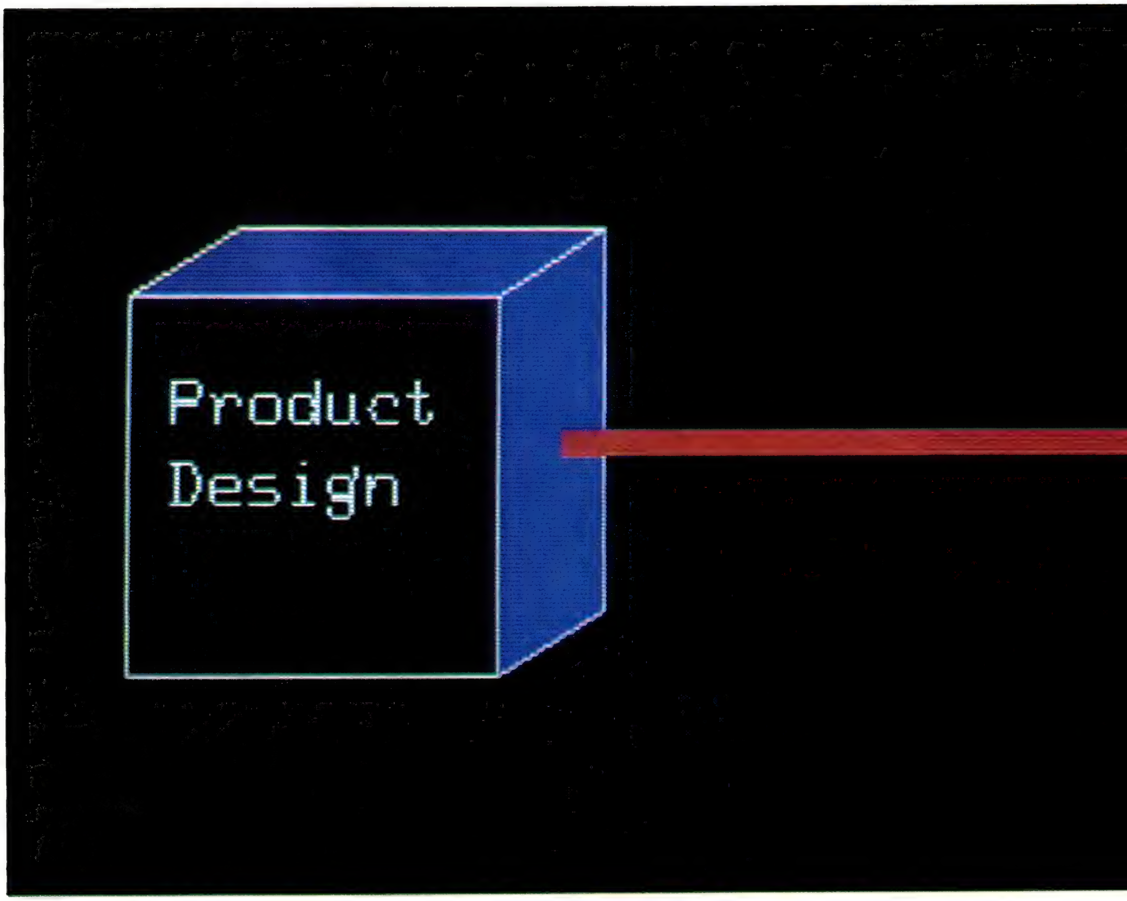
LASAR simulation software. The shortest distance between two points.



Teradyne presents LASAR™ Version 6. Simulation software created to help manufacturers speed products to market.

Now there's a tool that will really save you time when time is money. Here's how.

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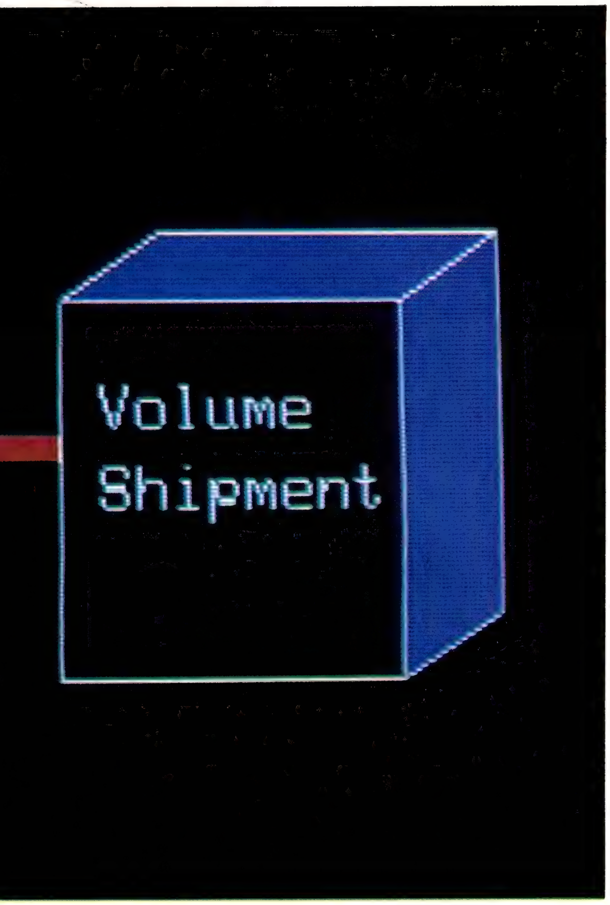

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ow LASAR saves test evelopment time.

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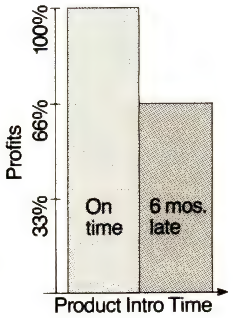

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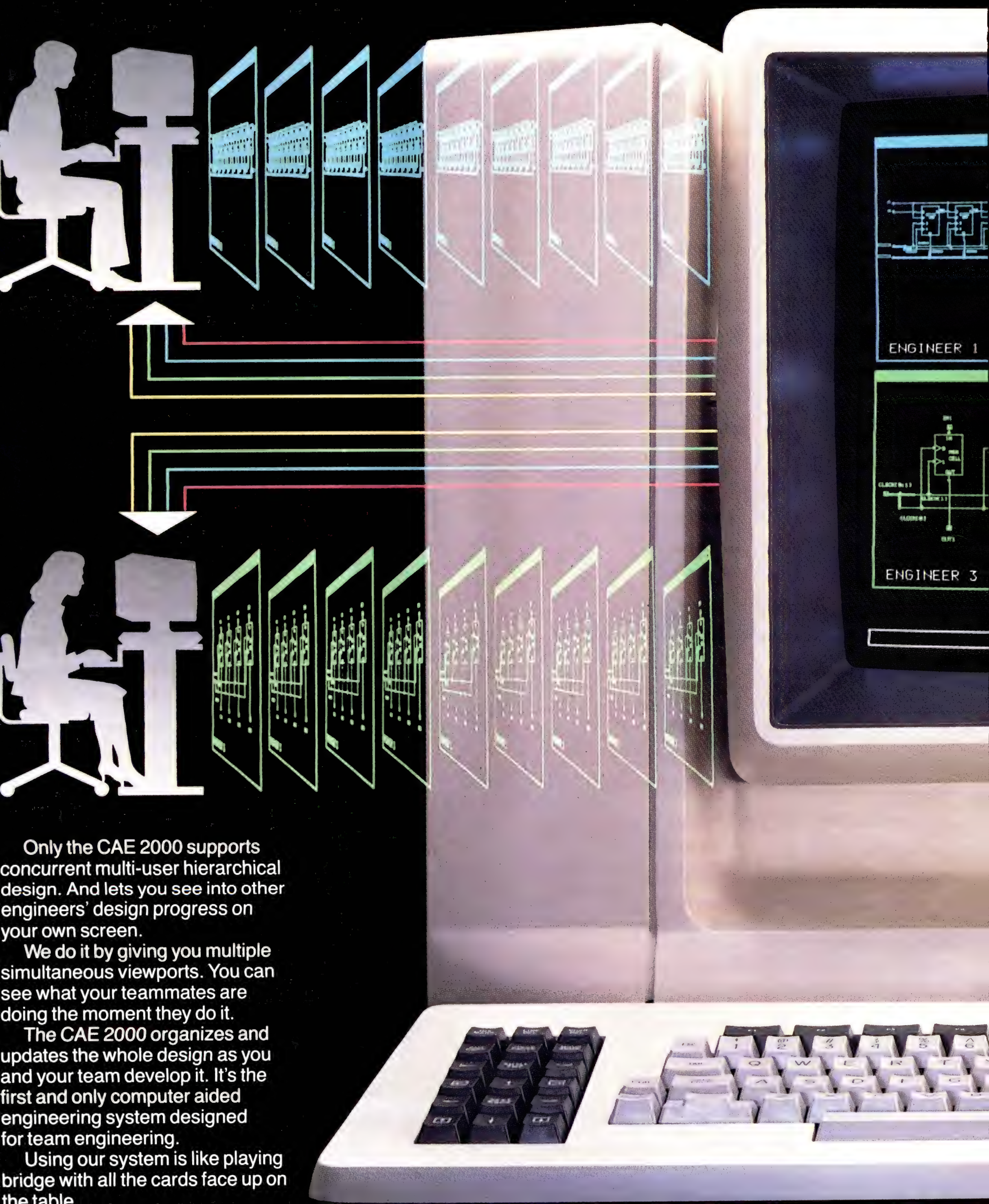

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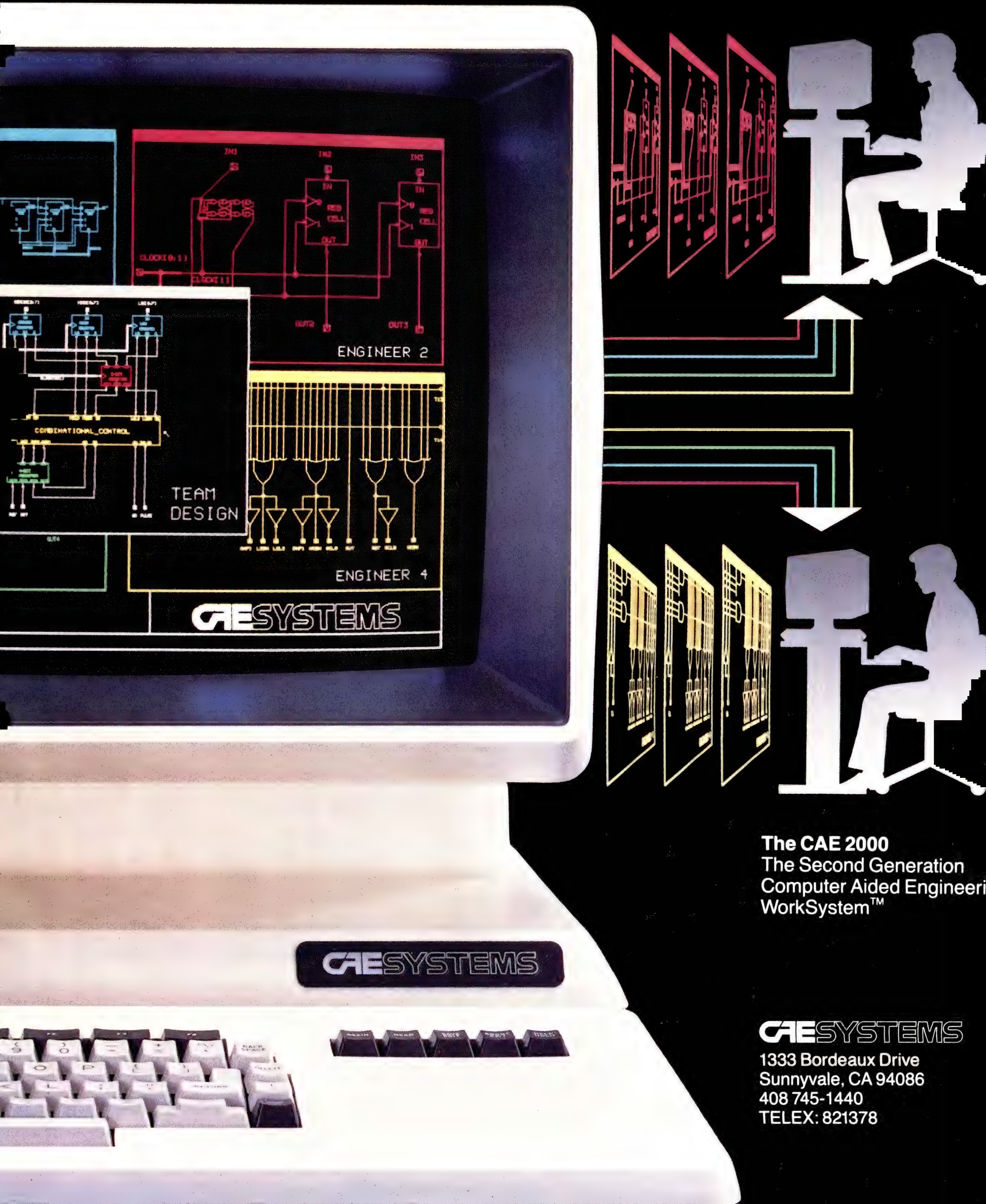

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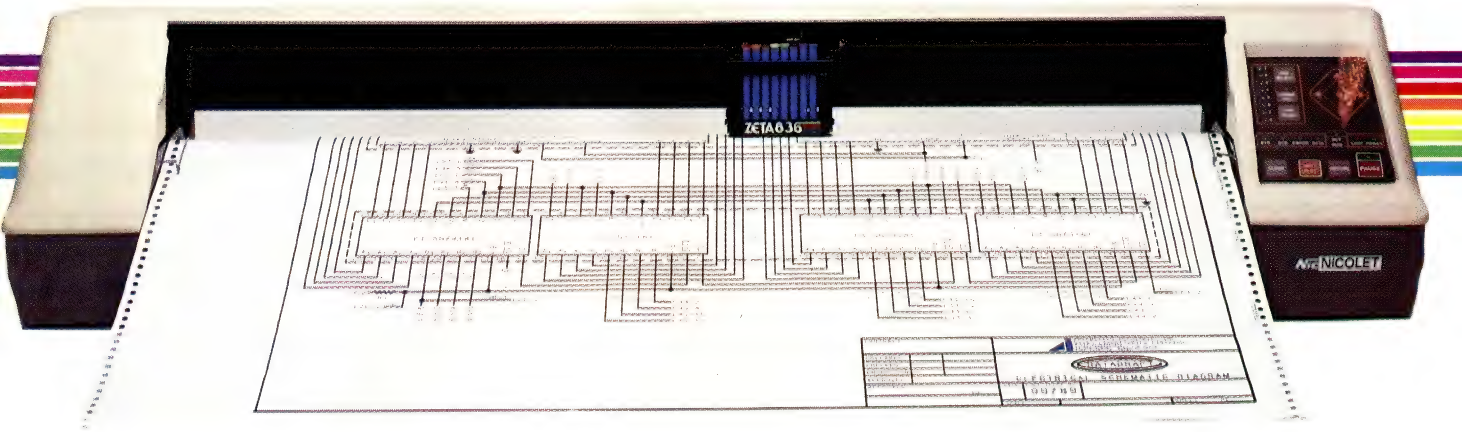

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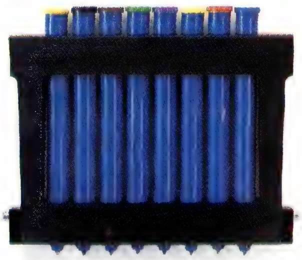

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Custom IC meeting joins select group

Quality of 121 papers puts it among top technical meetings as sixth annual event is expected to draw more than 1,000

The growing importance of custom and semicustom approaches to the design of very large-scale integrated circuits is strongly reflected in the growth of the Custom Integrated Circuits Conference. Although not yet as venerable as its older sibling, the International Solid State Circuits Conference, the CICC will celebrate its sixth year when it convenes in Rochester, N. Y., May 21–23.

For the occasion, it attracted more than 225 submissions of high-quality papers from all over the world, with approximately 11% of them from Japan and 10% from Europe. From the batch, 121 have been culled for the final program. As a consequence, the CICC is emerging as a top-class technical forum, with an anticipated attendance of more than 1,000.

The majority of the papers are being presented by representatives of systems houses, rather than by the merchant semiconductor producers that dominate the ISSCC. Thus the conference may be expected to attract an increasingly broader audience each year, no doubt parallelling the growth of the custom segment of the industry.

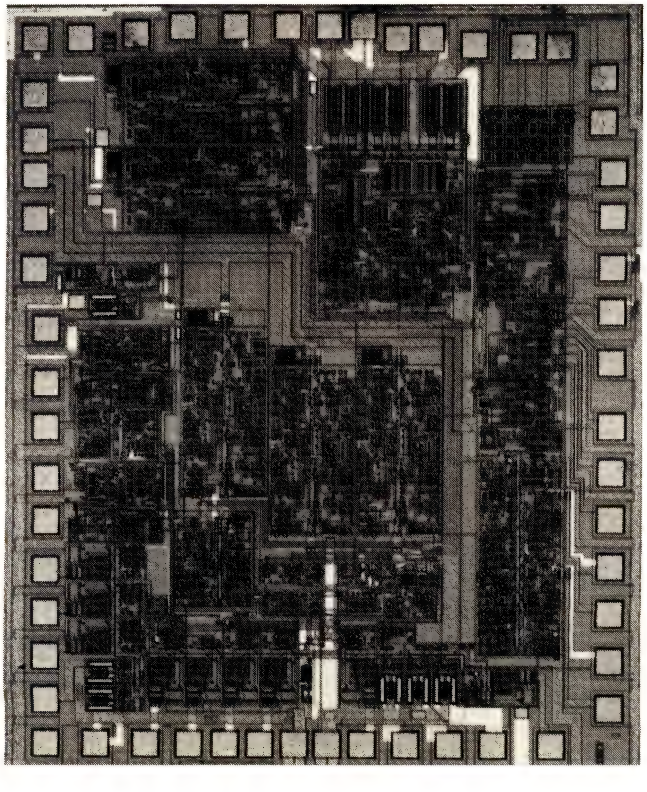
This year's program reflects the major concerns of the custom- and semicustom-IC community, including computer-aided-design techniques and tools, gate arrays, fabrication technology, testing, and reliability. Many unique applications of custom and semicustom techniques to specific chips will also be unveiled.

Bridging a gap. The conference's keynote address will be given by James E. Dykes, vice president and general manager of General Electric Co.'s semiconductor business division in Research Triangle Park, N. C. Dykes will posit that GE has become a microcosm of the electronics industry, with its triple role as a systems house requiring extensive use of VLSI, a custom-IC producer for captive and merchant markets, as well as a seller of turnkey CAD systems. He will address the problems of bridging the gap between these divergent, yet interdependent, groups.

As befits a conference on custom ICs, several of the sessions are devoted to various aspects of automated design, layout, simulation, and circuit synthesis. The first of these, a session on integrated design systems, features an invited paper titled "CAE Needs and Solutions for the Mid-80s," by D. A. Stamm, of Daisy Systems Corp., in Sunnyvale, Calif. Stamm will advance the theme that tool sets for the error-free development of chips from specification and synthesis through testing are vital to the proliferation of custom and semicustom ICs. He will be describing a powerful work-station environment—presumably a Daisy-based one—that incorporates such tools.

Kris Vorm, out of Austin, Texas, will describe a GE VLSI CAD system that has been used to design 10 complementary-MOS chips. The GE system encompasses system- and multilevel-logic simulation, physical chip design, chip verification, and testing.

At NCR Corp., San Diego, Calif., a newly developed hierarchical design approach has been applied to the design of the company's single-chip small computer system interface (SCSI). The methodology includes circuit schematic entry, simulation, and layout, as well as schematic consis-



Disk jockey. Mitsubishi packs 1,500 circuit elements—for both analog amplifiers and digital control circuits—onto this bipolar single-chip floppy-disk interface.

tency-checking features.

A presentation from TRW LSI Products of La Jolla, Calif., will describe IDS, a system for designing handcrafted ICs rapidly that guarantees functional first silicon. A top-down design methodology and a fast hierarchical connectivity verification program called Slave (for structured layout verification) contribute to shortened design-turnaround time.

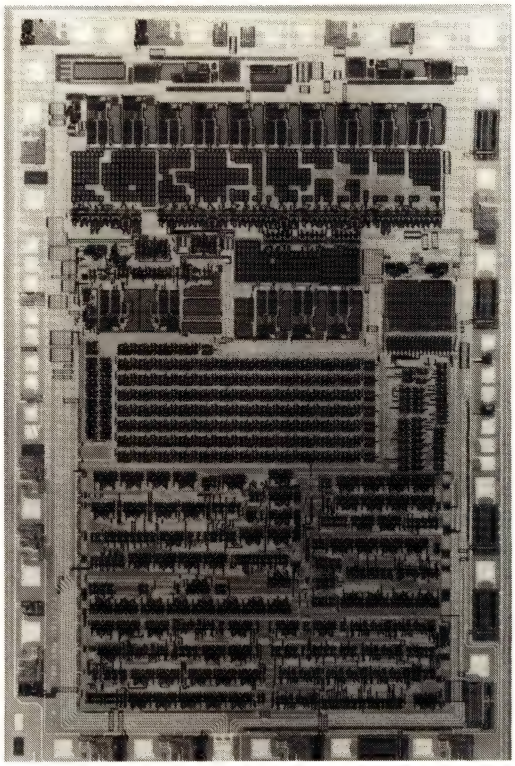
Silicon compilation. A related session on design synthesis is dominated by various approaches to silicon compilation, a technique of automatically synthesizing complex system designs from high-level descriptions. Researchers from International Business Machines Corp., in Yorktown Heights, N. Y., will present details of a silicon compiler they have developed that compiles a high-level-language description of a logic macro into a mask layout. The system uses a form of dynamic C-MOS logic called CVS (cascode voltage switch).

A Japanese approach to silicon compilation is embodied in an automatic logic synthesizer for VLSI design, called Angel, developed by the Atsugi Electrical Communication Laboratory. The laboratory will show how it can generate a mask pattern from a functional description and reduce the number of gates in a manually derived design by 50% to 70%. A similar system, called Expresso-II, will be described by a consortium of researchers from IBM, Yorktown Heights; the University of Colorado, Boulder; Harvard University, Cambridge, Mass.; and the University of California at Berkeley. Expresso-II is billed as an advanced CAD tool for multiple-output two-level logic minimization, able to handle large functions.

Dense and fast. The conference will also tout an impressive group of advanced gate arrays. In sheer number of gates, the all-out winner is from M. P. Gagliardi of GE at Research Triangle Park, who will discuss a C-MOS array with an internal gate count he says exceeds 13,500 and that features 2-micrometer gate lengths and 1.2-nanosecond inverter delays with a fanout of two.

NEC Corp., Japan, is a close runner-up with an 11,250-gate array that uses double-layer metal, also in a 2-μm process and with a gate delay of 2 ns. Third place goes to Hewlett-Packard Laboratories, Palo Alto, Calif., whose 10,00-gate, 1.5-μm n-well C-MOS array can meet a target of 100% automatic routing of logic designs with 95% gate utilization. The laurel for speed goes to Applied Micro Circuits Corp., of San Diego, with a 3,500-gate bipolar array featuring delays of only 350 picoseconds as well as both emitter-coupled-logic and TTL input/output interfaces.

The importance of testing and achieving reliability are underscored by two full sessions, each headed by a tutorial and an invited paper, and by an evening panel discussion on "The Ultimate Price of Quality in Custom ICs." One session will explore the important topic of test considerations in IC development. A tutorial by D. L. Denburg of AT&T Bell Laboratories, Allentown, Pa., will explore the distinctive test facilities and computer aids required to support a custom-IC development environment. An AT&T Bell Laboratories contingent from Murray Hill, N. J., will then describe Titus, a design-automation system that, besides checking a circuit for conformance to design rules, generates test routines.



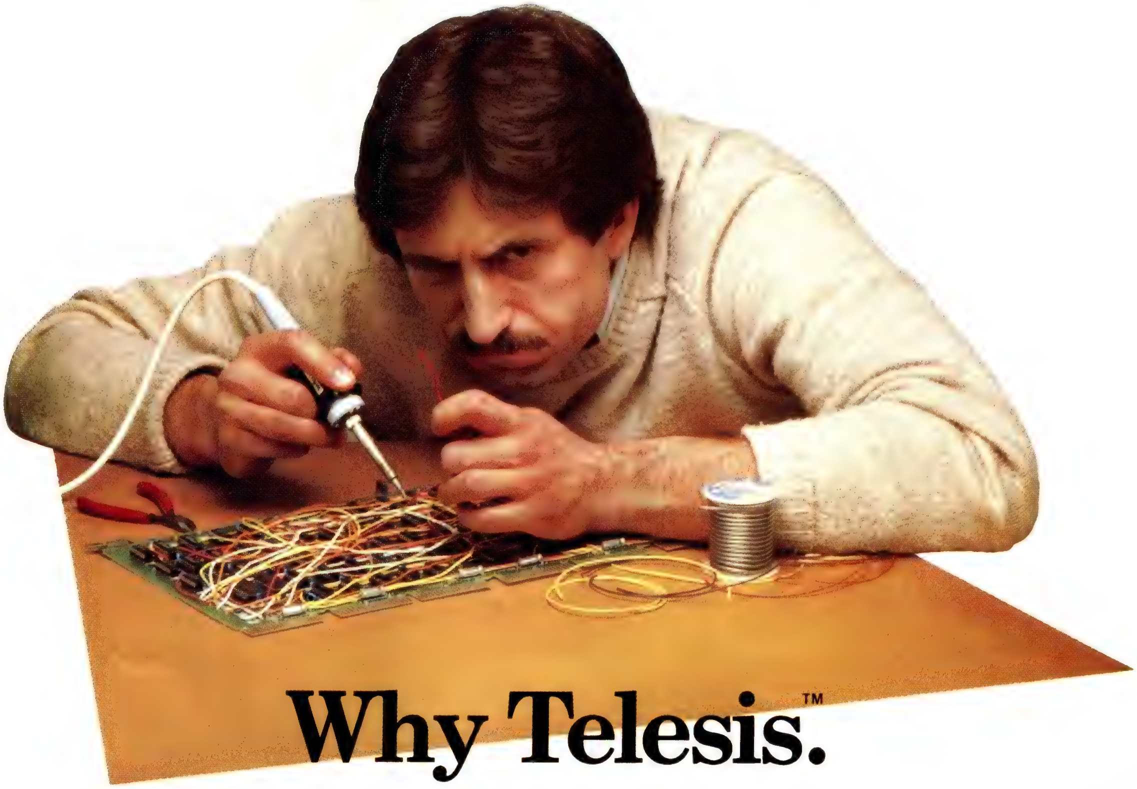
Rarely errs. Fujitsu builds its single-chip 1,200-bit/s radio modem in double polysilicon C-MOS. The part has a bit error rate of only 0.4% at 8-dB signal-to-noise ratio.

From Lehigh University, Bethlehem, Pa., A. K. Susskind's survey of VLSI logic test strategies will characterize available options based on fault coverage, hardware cost, test generation, test execution, and other factors. H. S. Lehman, from IBM in White Plains, N. Y., will follow with an invited paper on semiconductor-component quality.

Some of the new chip designs for new applications include:

- ■ A C-MOS high-speed codec from Hitachi Ltd., Japan, implemented in a 2-μm process. Designed for a facsimile system, the codec includes an 8-K read-only memory, a 512-by-48-bit random-access memory, a 2,500-gate execution unit, a 1,700-gate encoder/decoder, and a 1,700-gate controller.
- ■ A monolithic MOS silicon pressure sensor from NEC Corp. that combines two piezoresistors and a silicon diaphragm with operational amplifiers on one chip.
- ■ A high-speed vote-tallying chip from the University of Rochester, Rochester, N. Y., that constructs a histogram from a stream of samples.
- ■ A single-chip 1,200-bit/s MSK (minimum-shift keying) modem, from Fujitsu Ltd., that is suitable for multichannel access as well as for Japan's recently introduced Personal Radio System, a communications system.
- ■ A single-sideband modem for frequency-division multiplexing systems from Harris Corp., San Carlos, Calif.
- ■ A C-MOS two-chip controller for cellular radio systems from Siemens AG in Munich, West Germany.
- ■ A three-chip high-performance MOS microprogrammable multiprocessor from Honeywell Information Systems Italia.
- ■ A 1,500-element single-chip floppy-disk-drive interface from Mitsubishi Electric Corp. ☐

Why CAD/CAM



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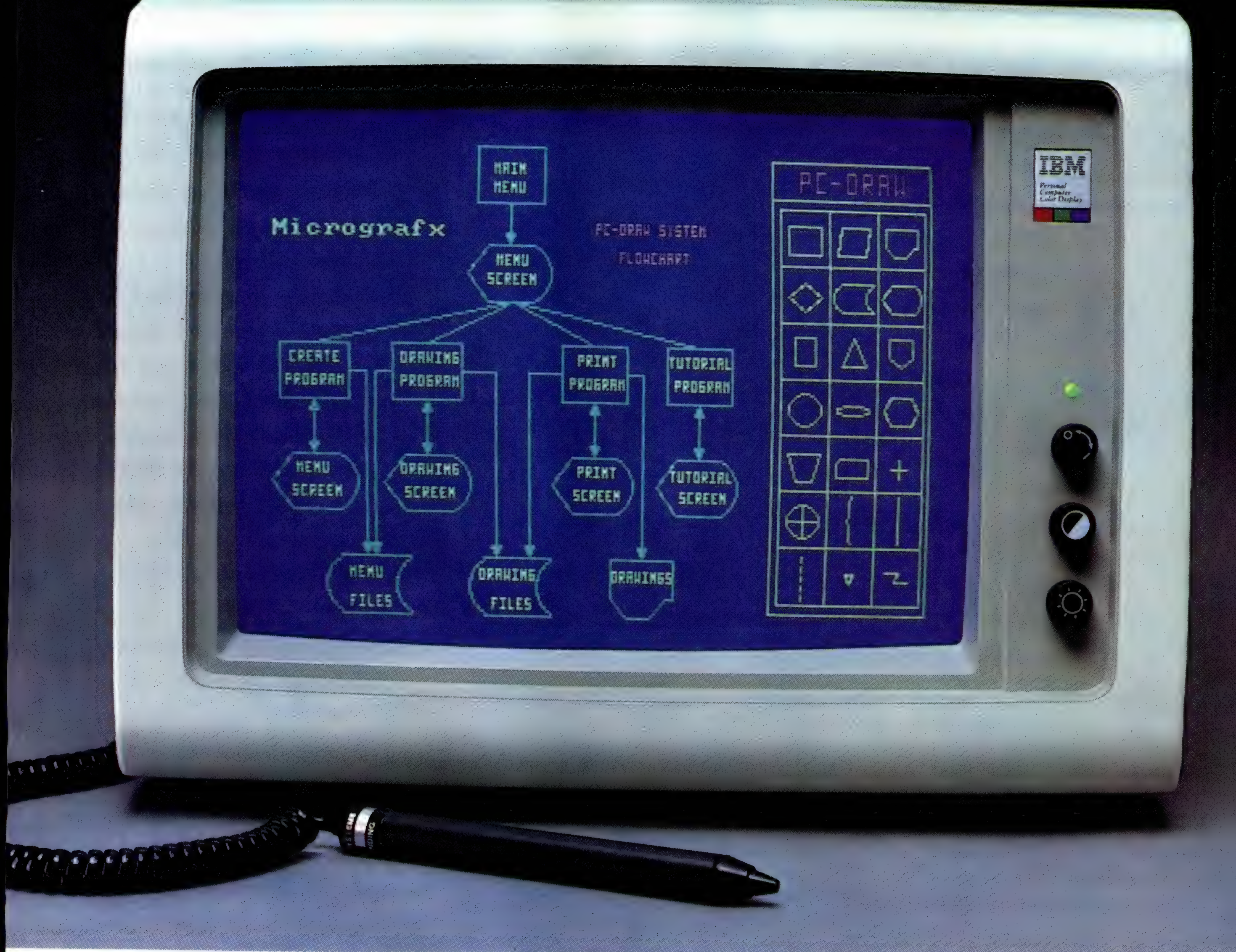

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Business abroad

Germany spends for its high-tech future

A billion dollars have been earmarked to help keep the country from falling further behind its international competitors

by John Gosch, Frankfurt bureau manager

It was a long time in coming, but in March, when West Germany's Ministry for Research and Technology finally released details of a program to boost the country's electronics industries, most observers were surprised. After all, the program [*Electronics,* March 22, p. 64] came from a conservative government usually opposed to interventionism.

The startling thing was not so much the amount of money involved, although the nearly $1.14 billion to be spent from 1984 to 1988 is more than would suit some Germans—the unions, for example, which think there are better uses for it. What surprised people was the program's sweep and inclusiveness. "We now have a total concept," says Günter Marx, a senior official in the Research Ministry and one of the authors of the Government Report on Information Technology, a 120-page document outlining the program.

As its title suggests, it is not aimed at any one sector of electronics, such as components or computers; unlike previous funding schemes, the program will help almost the whole industry, including communications and industrial automation—in short, everything the Germans include within *Informationstechnik.*

Further, Marx says, the program takes into account the needs of the ministries of defense, communications, and transportation, as well as the Bundespost (post office). It also urges private institutions to invest more venture capital to help young companies with good ideas get off the ground. And it makes a strong plea for closer links between industry and academia.

Another difference between the current program and its predecessors is the industry consensus behind it. Former aid packages were plagued by such shortcomings as the indiscriminate allocation of funds, primarily to big firms. This time around, 15 companies, big and small, helped plan the program, including AEG-Telefunken, Siemens AG, Triumph-Adler AG, Nixdorf Computer AG, and Philips' German subsidiaries.

Research support. The Research Ministry will not support sales and marketing—only research and development, and that up to a limit of 50% of its cost. Moreover, the $1.14 billion has been set aside only for projects administered by the Research Ministry. However, these outlays will be supplemented by much higher, though as yet unspecified, expenditures for electronics procurement by the military and civil sectors. In the near future, the Bundespost alone is expected to shell out as much as $750 million a year for broadband communications.

The aims of the program are clear: to stimulate progress in the electronics industries and "to create a better climate for a broader acceptance of information technology," as Marx puts it. Ultimately, the idea is to create jobs and, above all, to keep West Germany from falling further behind its key competitors—notably the U. S. and Japan—in the high-tech race, both on Germany's home turf and in international markets.

Of the $1.14 billion in aid, the biggest chunk, $535 million, is slated for the components industries. Nearly $231 million will be spent to fund a multifirm submicrometer-technology project that should have chips in volume production by the second half of this decade.

Also in components, about $123 million has been earmarked for what the Germans call *Mikroperipherik,* meaning intelligent microelectronics-compatible peripheral components, such as sensors. New device technol-

Playing catch-up. Heinz Riesenhuber, West Germany's Research and Technology minister, says only a strong information technology can save the classic industrial sector.

ogies will get about $77 million, and integrated optics, computer-aided integrated-circuit design, and special microelectronics components will get almost $35 million apiece.

Another major industry sector, data processing, will receive $200 million, which will be used to support R&D in CAD for hardware and software, new computer architectures, knowledge processing, and pattern recognition. Industrial automation is in line for $204 million, primarily for CAD, computer-aided manufacturing, and robotics.

The remaining $200 million of the aid package will support R&D in optical communications, broadband distribution networks, a special communications network for research institutes, and basic research in information technology.

The right stuff. Although some industry officials doubt that the funds have been divided up in the best possible way, by and large they laud the program. "We consider it a big stimulus for the information-processing industry, including the microelectronics sector," says Hans Weinerth, director of the Technical division at Valvo GmbH, in Hamburg. "We think it will enhance the per-capita consumption of electronics in Germany, which at present is much lower than it is in the U. S. and Japan."

Herrmann Franz, a member of Siemens' management board and head of the company's semiconductor activities, calls the program "a step in the right direction—one that will help our competitive stance in information technology and related fields." He welcomes the emphasis on microelectronics, since it is the basis for "the office of the future, the networks of the future, and the factory of the future."

From all indications, West Germany's electronics industry clearly needs a shot in the arm to improve its position in foreign markets. To be sure, West Germany's overall trade posture is remarkably strong. Research Ministry statistics show that in 1982, West Germany was No. 1 in exports of finished industrial goods. It was second only to the U. S. in the volume of total exports. The country's 1982 sales abroad accounted for 31% of the gross national product, as compared with 18.2% for Japan and 9% for the U. S.

Even so, West German electronics sales are slipping badly in foreign markets. The Bundesbank—comparable to the U. S. Federal Reserve—has found that the country's share of all data-processing and communications equipment, semiconductors, measuring instruments, and medical-electronics gear exported by the six major electronics-exporting countries—the U. S., Japan, West Germany, the UK, France, and Switzerland—fell from 26.3% in 1972 to 17% last year.

Between 1972 and 1983, Japan almost doubled its share—to 25%, from 13%—pushing West Germany into third place. The U. S. strengthened its position to 37% from 32%. To be sure, the West Germans did well in medical equipment and high-precision instruments, but the Bundesbank's study points up some basic weaknesses in Germany's overall performance.

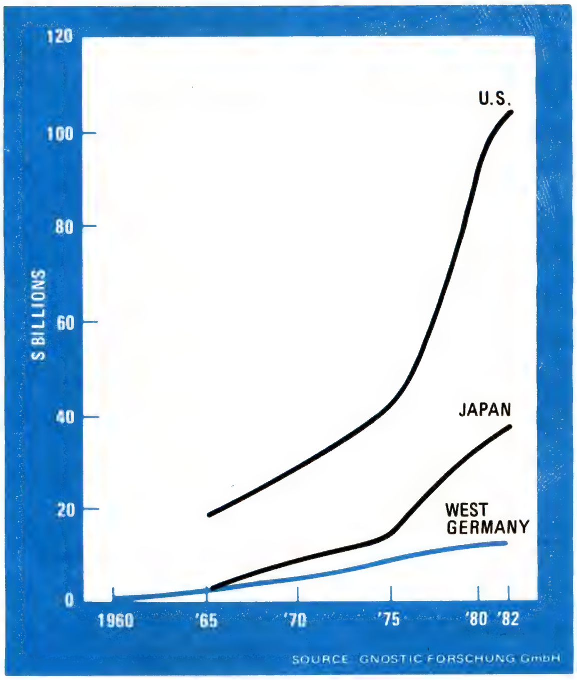
So too does the Research Ministry's report, which lays bare the shortcomings of West German electronics and gives a plain-spoken assessment of the country's position in various sectors. In the U. S. and Japan, the production of information-technology equipment—components, as well as communications, consumer-electronics, data-processing, and industrial-automation gear—is rising sharply. But in West Germany, it is rising at a far less impressive pace. With semiconductors, matters are much the same: while consumption is growing by leaps and bounds in the U. S. and Japan, in West Germany it is progressing slowly.

"Production [of ICs] is insufficiently developed," the report says. Citing the findings of U. S. and German market research institutes and trade agencies, the document notes that the U. S. and Japan produced more ICs in 1982 than they could consume domestically, so the surplus went abroad—mainly to Europe. West Germany covered only 60% of its IC needs from home production.

In entertainment electronics, once Germany's pride and joy, export surpluses started dwindling in 1976. In 1981, imports exceeded sales abroad for the first time—by about $200 million. Meanwhile, Japanese producers have cornered roughly 25% of the West German entertainment-electronics market.

As for data processing, although West Germany accounted for about a quarter of Europe's 1982 market, the country ran a distant third in sales: $3.7 billion, for only 7% of the world's 1982 data-processing market, compared with $24.1 billion for the U. S. and $6.2 billion for Japan. The country's data-processing industry has all but neglected the low-end computer sector—personal computers, Europe's fastest-growing market and one that is dominated by U. S. producers.

Finally, in industrial electronics, West Germany's relatively strong position in custom robots has been offset by standard Japanese equipment that can be of-



SOURCE: GNOSTIC FORSCHUNG GmbH

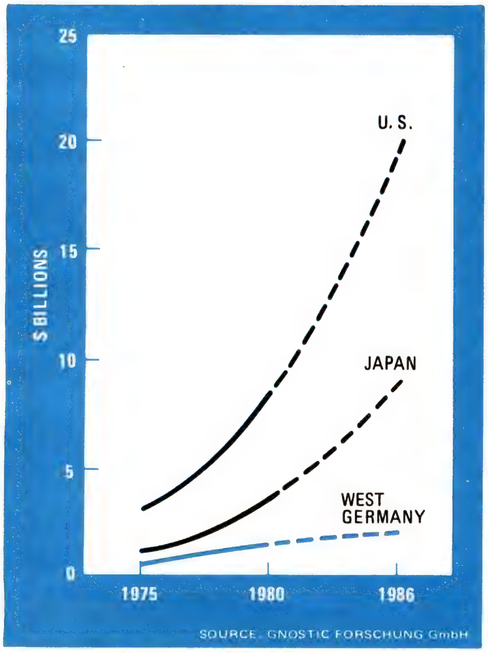
Behind. Information-technology-equipment production figures (for communications, components, consumer electronics, data processing, and industrial automation) show Germany's lag.

fered at low prices thanks to large production runs. Much remains to be done with CAD and related equipment, too. Warns the report: "in this area, a dependence on foreign equipment could come about."

Dark cloud. Just why Western Europe's leading economy has lagged behind in electronics is the subject of a lively debate in German industrial and research circles. This technology gap is often discussed with a Wagnerian sense of gloom, and as hotly as was the missile gap vis-à-vis the Russians that rocked the U. S. in the early 1960s. Many observers believe that West Germany's economy has been too heavily dependent on the classical fields of precision mechanics and optics, as well as on the lethargic sector of electrical engineering. For too long, Germany has relied on smokestack industries that created the postwar "economic miracle" but blinded many firms to the benefits of such emerging fields as electronics.

Many companies were left at the station as the Japanese came chugging in. Now West German companies are struggling to get on a high-technology train that is going faster and faster, a dangerous game that has broken many a firm's back. Having failed to face the challenges of modern electronics, once-proud names in German *industry* are no longer on the passenger list.

Max Syrbe, president of the Fraunhofer Society, a multi-institute establishment that performs contract research for government and industry, cites two chief causes of the technology gap. During the 1970s, he says, the German public was not willing to accept application-oriented industry-financed research at universities and other institutions of higher learning, reasoning that such places were meant solely for teaching. The result was a widening gap between the universities and industry—a gap that opened up just as the two should have been cooperating to develop the technologies of the future.



SOURCE: GNOSTIC FORSCHUNG GmbH

Bad news. A projection of semiconductor-component markets (in billions of U. S. dollars) shows West Germany tapering off as product demand in the U. S. and Japan will continue to climb steeply into the 1990s.

Syrbe says that the other cause of the technology gap was industry's reluctance to take risks in the 1970s and its habit of instead emphasizing short-term gains. "Lamentations about difficult times have hampered entrepreneurship and the will to perform. So we now have a lost decade to make up."

Silver lining. Even so, like many research and industry officials, Syrbe is hopeful for the future. "Things have been changing of late, with the forces that have led to the technology gap receding fast. A technological spring is in the air."

Syrbe ticks off a number of developments that support his view. Like the federal government, the states have recognized the importance of electronics to their economies, he says. They too have embarked on aggressive R&D funding programs—for instance, state- and city-supported science parks in West Berlin, Stuttgart, Heidelberg, and other cities where young companies have formed pockets of high technology.

After a wave of bankruptcies, the industry wants its potential for innovation to act as the performance yardstick, rather than short-term considerations. The power of financial controllers has been cut back and that of innovation-oriented researchers and developers increased. The proof is that last year, German industry spent some $10 billion for R&D, 6.2% more than it did the year before. The mood of pioneering enthusiasm is further shown by the establishment of venture-capital firms that are providing seed money for young companies with innovative ideas and trying to foster the kind of entrepreneurship that has created high-tech communities in the U. S.

Links between the industry and academia are forming, too. Many companies are commissioning research from universities and drawing on faculty expertise; universities are benefiting from resources of nearby firms.

Thumbs up. At many companies, both big and small, a can-do spirit has largely replaced the former atmosphere of resignation. Companies point with pride to developments that could put them on par with, or even ahead of, their U. S. and Japanese competitors. Examples are digital signal processing in color TV sets, made possible with very large-scale ICs from Intermetall GmbH; the integrated teletex decoder, a highly complex IC from Philips in Germany and the UK; and a microprocessor-adjusted TV tuner from Telefunken electronic GmbH.

One of the most ambitious private programs designed to help Germany catch up with the U. S. and Japan is the $200 million 1-megabit random-access-memory project Siemens launched earlier this year. West Germany's largest electronics producer, already producing a million 64-K dynamic RAMs a month, is now preparing to produce 256-K RAMs. It wants to become more of a heavyweight IC contender and to push itself into the forefront of 1-μm-and-below technology for volume-produced parts by making possible the circuit densities needed for 1-Mb memories and future highly integrated logic devices.

Thus, West Germany has apparently awakened to the challenges of the future. If the government continues to recognize the importance of electronics, if venture capital continues to foster entrepreneurship, if industry and the universities continue to work together, and if firms continue to forsake short-term prizes for long-term benefits, the country may yet pull off a "technological miracle" reminiscent of the postwar economic miracle. ☐

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Displays

Technologies vie for dominance

While CRT advances and full-color flat-panel displays lead the pack, voice entry, 3-d brighten the picture at SID's display symposium

by Ashok K. Bindra, Components Editor

As the newest advances in display research are paraded in San Francisco next month, the emerging technologies of voice-entry and three-dimensional displays will march with the latest in traditional display technologies, device characterization, fabrication, and systems integration. The occasion is the Society for Information Display's 1984 symposium, June 5–7, a conference featuring 88 papers from around the globe.

Highlighting the growing market for data display in the home of the future will be a keynote address by Robert W. Lucky, executive director of research at the communication sciences division of AT&T Bell Laboratories. In the same opening session, Gene Lynch, chairman of the American National Standards Institute's committee on display ergonomics, will discuss the impact of standards on the display community, and astronaut Loren J. Shriver will describe the displays that are used in the space shuttle.

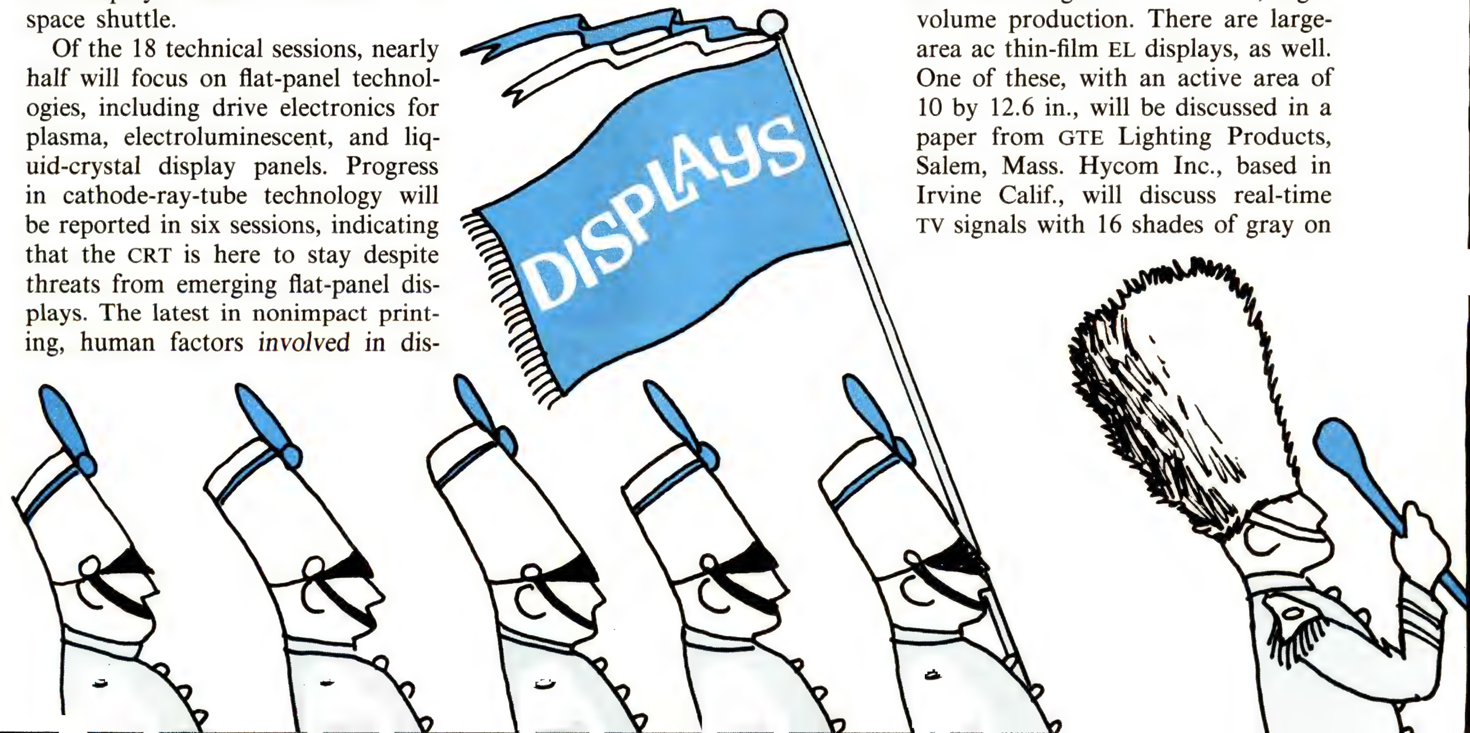
Of the 18 technical sessions, nearly half will focus on flat-panel technologies, including drive electronics for plasma, electroluminescent, and liquid-crystal display panels. Progress in cathode-ray-tube technology will be reported in six sessions, indicating that the CRT is here to stay despite threats from emerging flat-panel displays. The latest in nonimpact printing, human factors involved in display designs, and voice data entry will also be examined.

In session 16, the supporters of CRT technology will flex their muscles. For example, Conrad Odenthal, a researcher at Tektronix Inc., in Beaverton, Ore., will describe a 19-inch, very-high-resolution CRT capable of displaying 3 million picture elements (1,500 by 2,000) with a minimum brightness of 30 footlamberts. Deflection defocusing and electron-beam aberrations in the tube can be corrected dynamically through the use of astigmatism and focus-control grids.

New CRT yoke. Kern N. Chang of RCA Laboratories, in Princeton, N. J., will present a novel deflection yoke, developed for a 19-in. CRT, that is integrated with the electron gun and mounted inside the vacuum glass envelope. Improved resolution has been demonstrated, and significant savings in cost and energy consumption are anticipated.

Electroluminescent panels continue to grow bigger and brighter. New materials for color and luminous efficiency, as well as integration of drivers with panels, have been reported, making EL panels commercially viable. Scientists at Planar Systems Inc., in Beaverton, Ore., have identified strontium sulphide as an efficient host material for thin-film EL displays. When doped with cerium trifluoride, the result is a bright blue phosphor with an efficiency of 0.15 lumen per watt.

From the British firm Phosphor Products Co., based in Poole, comes news of a 2,000-character dc EL panel that utilizes a novel method for connecting the display panel to the drivers. Based on a zinc sulfide-manganese powder phosphor technology, the panel displays 24 rows of 80 characters with a brightness of 25 fL. The display measures 6.8 by 9.6 in. and was designed for low-cost, high-volume production. There are large-area ac thin-film EL displays, as well. One of these, with an active area of 10 by 12.6 in., will be discussed in a paper from GTE Lighting Products, Salem, Mass. Hycom Inc., based in Irvine Calif., will discuss real-time TV signals with 16 shades of gray on



a thin-film EL panel.

With gains in high-speed, high-voltage-driver integrated circuits, plasma panels continue to develop in the display market. In fact, an 8-in. color-TV panel using plasma technology has been produced by NHK Technical Research Laboratories, in Tokyo, and will be the subject of discussion in session 7. A new driving method using a pulse-discharge technique has produced color-TV pictures with 256 gray levels, and luminance of 40 fL. Similar efforts are under way in Tokyo at Hitachi Ltd.

International Business Machines Corp.'s display division, in Kingston, N. Y., will report on the operation of a standard ac plasma panel in video mode. A 350-by-720-element section of the panel was driven by an IBM Personal Computer at a 50-hertz refresh rate. In another development, self-scanning-memory plasma-display operating techniques will be discussed by George E. Holz of Plasma Graphics Corp., Plainfield, N. J.

Active matrix addressing for liquid-crystal displays represents one of the most exciting and fastest-developing technologies in the flat-panel arena. Several manufacturers have announced prototypes of LCDs addressed by thin-film transistors fabricated using a variety of TFT materials and processing techniques. In addition, metal-insulator-metal and Schottky-diode arrays are being developed for similar applications. Six papers in session 18 will highlight achievements in this field.

Color LCDs. Suwa Seikosha Co. of Japan, which surprised many last year with its announcement of a small, color LCD TV using a polysilicon-TFT-addressing technique, will present new 4.25-in.–diagonal black and white and full-color LCD panels with 480 by 480 pixels addressed by polysilicon-TFT arrays. The same paper will also discuss a 1.51-in.–diagonal LCD in both black and white and full color. The only difference between the two is that the larger panel is addressed by external drivers while the smaller one, with 180 by 210 pixels, has completely integrated drivers.

In an attempt to mass-produce cheap pocketable TVs, Seiko has developed a liquid-crystal TV addressed by metal-insulator-metal devices. Seiko scientists will discuss their 3-in.–diagonal LCD TV, which employs the new metal-insulator-metal driving method. Coupled with parameters for better gray tone determined by computer simulation, it results in a high-resolution, 220-by-220-pixel, twisted-nematic LCD.

Printer topics

As the computer revolution continues apace, the need for high-quality, low-cost printers increases, and a number of companies are developing new techniques to meet these demands. Researchers from two European facilities will describe their developments at the Society for Information Display symposium. From Sweden's Lund Institute comes a new method for ink-jet character printing, and Philips, in Hamburg, West Germany, will disclose a bilaminar piezoelectric transducer that allows the construction of compact and simple multinozzle print heads. **–A. K. B.**

Also, Hosiden Electronics Co. of Osaka will surprise many with its 7.23-in.–diagonal color LCD, addressed by amorphous-silicon TFTs—one of the largest color LCD panels to date. Yet another Japanese manufacturer in this fray is Citizen Watch Co. of Tokorozawa. At Citizen, researchers have developed a 120-by-160-pixel LC TV with gray scale. The display uses an amorphous-silicon diode ring as the active element.

With each flat-panel technology continuing to evolve rapidly, new applications are being created. A few novel applications will be explored in session 12. General Motors Corp.'s Technical Center, in Warren, Mich., is investigating a full-dashboard graphics-instrument cluster, implemented by a display system. Another group of authors from CrystalVision Inc., in Sunnyvale, Calif., will discuss a thermally addressed 2,000-character LCD panel that includes interface and drive electronics for graphics and alphanumeric applications. Texas Instruments Inc., in Dallas, will demonstrate a portable EL display with membrane keypad and voice input/output.

The competitive market for displays and terminals is forcing display makers to consider the physiological and psychological factors as well. These concerns will be expressed in session 17. A paper from IBM, for instance, compares a number of people doing the same work, some with CRT displays and some with paper. No change in the participants' proofreading performance, feelings, or vision throughout a day could be attributed to the use of CRT terminals, concludes the paper.

Looking at 3-d. The growing interest in improving displays has prompted some to investigate the 3-dimensional effect. Two papers in session 8 will explore this emerging field. A paper from the Bright & Morning Star Co., Lawndale, Calif., will unveil a multifunctional auto-stereoscopic image-display system, and another from Stereographics Corp., San Rafael, Calif., will suggest solutions to the problem of stereoscopic video.

Inspired by the success of touch-entry displays, researchers are now developing voice-entry panels for both commercial and military applications. Voice control of displays will be reviewed in a paper from the Naval Ocean Systems Center in San Diego, Calif. Still another paper, from Verac Inc. of San Diego, will discuss using the pilot's voice to achieve display and control of the aircraft system.

The current interest in color displays for a variety of applications, including military and airborne, has generated the need for new analytical tools for the evaluation of visual color parameters, and these will be addressed by six papers in session 6. For example, what RCA calls its "just-noticeable-difference analysis" allows the evaluation of images in terms of a model of human vision.

Color perception, in particular, hue identification, is important in the cockpit of an aircraft, where the ambient illumination changes frequently. Kaiser Electronics, of San Jose, Calif., will describe a technique providing automatic chrominance to correct this degradation. ☐

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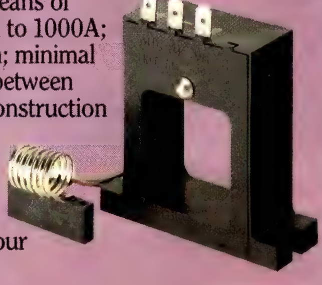

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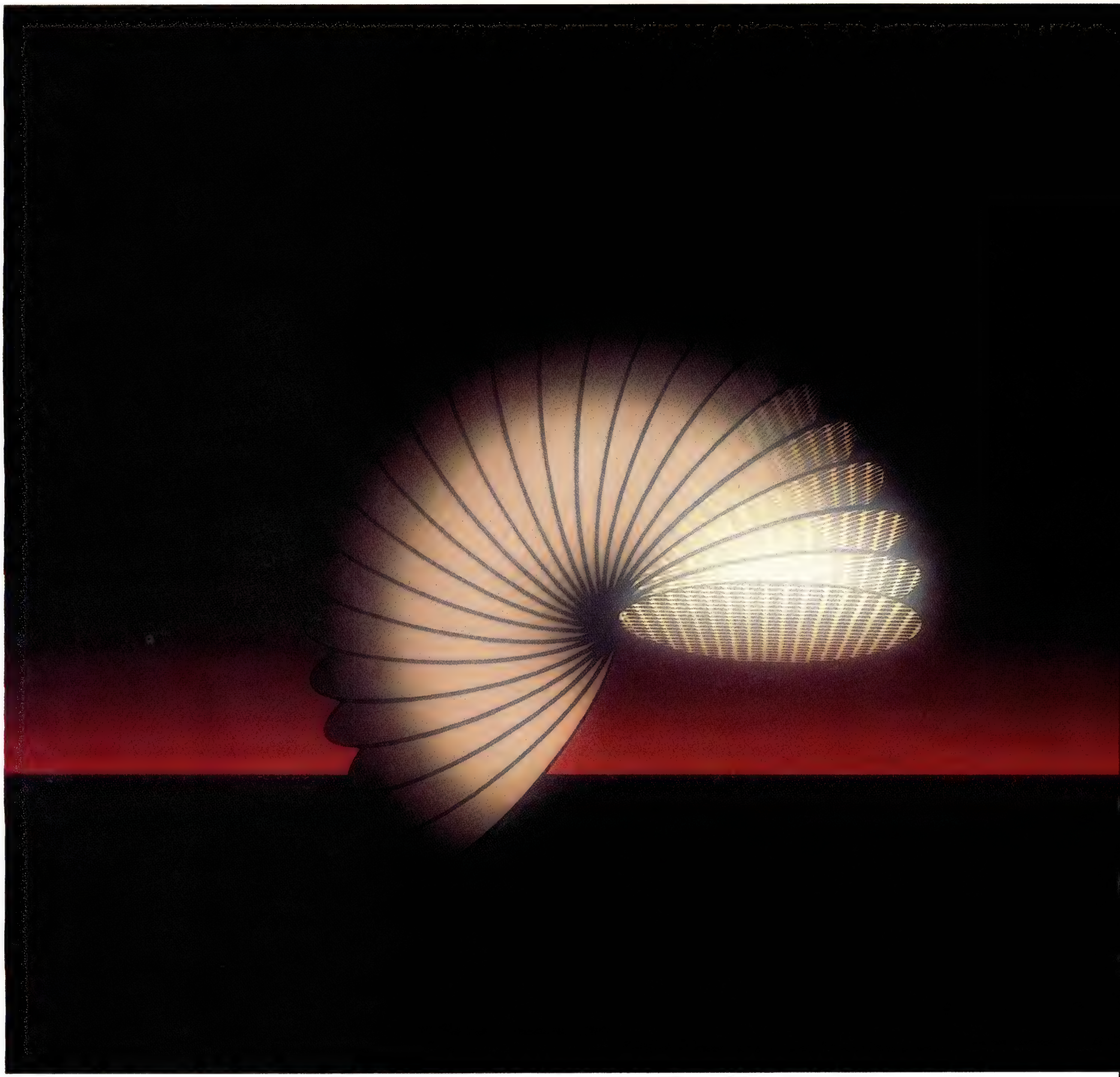

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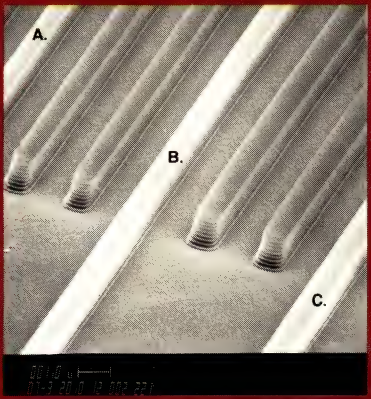

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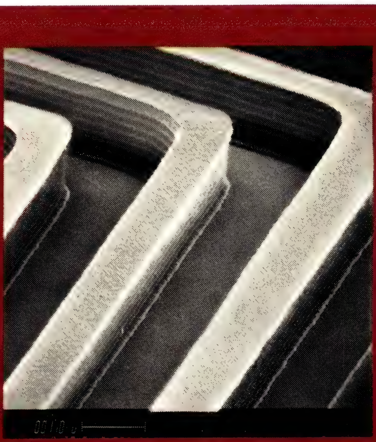
SEM prepared on the SRA-100 showing equal lines and spaces printed in 1.0μm of photoresist.



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Manufacturing

Wafer automation steals the show

IC processing, testing, and quality control by machine, plus computer-controlled manufacturing fill Semicon/West

by Jerry Lyman, Packaging & Production Editor

Automation is virtually a password to the future in semiconductor manufacturing. As makers of integrated circuits add capacity during the economic recovery, automated manufacturing is the key. So it is no surprise that automated manufacturing is the theme of the Semicon/West technical symposium, May 22–24, in San Mateo, Calif. The three-day meeting will cover three broad areas: process automation, test and inspection, and system automation.

In process automation, sessions will explore a number of examples in which wafer processing's critical steps—among them wafer handling, lithography, and plasma etching—are being performed by machines. Test and inspection will cover not only highly automated systems for those two operations but also their use in repairing processed wafers. The final session will focus on software, architecture, and simulation modeling for complete computer control of IC fabrication lines.

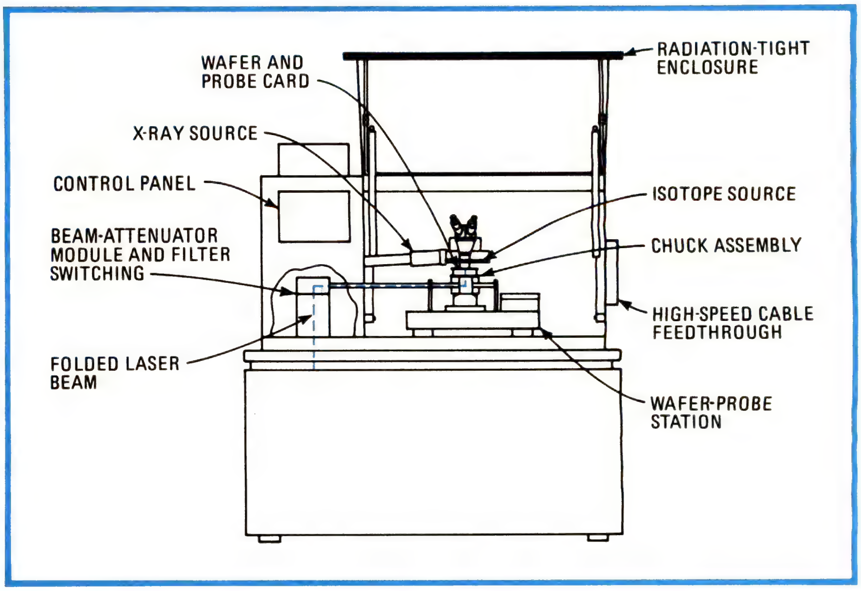
One of the outstanding papers of the meeting is by W. E. Armstrong, of Intel Corp. in Albuquerque, N. M., on "The User View of Automation for 150-mm Wafer VLSI Production." The subject is central to planning equipment and production lines for any firm making ICs or IC-processing equipment.

Basically, Armstrong describes Intel's experiences in getting its 6-inch-(150-millimeter) wafer line at Albuquerque into full production. Drawing upon the experience, he notes that going to the larger, 150-mm size not only carries certain advantages but at the same time manages to magnify some of the handling problems that semiconductor manufacturers have experienced with smaller wafers. In light of these problems, manufacturers are rapidly turning to automation as they produce the next generation of products.

Yield dominant. Armstrong emphasizes that the level of automation must depend on the increased product-yield return that automation can achieve, rather than on any anticipated reduction in labor costs. If the automation is reliable, the result will be improved line yield, he says, while labor savings are generally canceled by the high cost of the necessary skilled maintenance personnel. Indeed, Armstrong points out that unless automation equipment dramatically improves in both reliability and ease of maintenance, companies at out-of-the-way locations might have to abandon plans to automate for want of a highly skilled labor force.

The author predicts that 6-in.-wafer automation will come in four stages. First will be cassette-to-cassette handling, followed by unattended operation. Then there will be a period of self-monitoring and self-setup, with the fourth stage covering a work-in-progress transport and management system. This last phase will be by far the most difficult for the industry to accomplish, because it will require a software and hardware system able to communicate with *all* equipment and flexible enough to handle all processes.

Two especially pertinent papers to be presented at the test and inspection session concern the economics of laser repairs on future 1-megabit dynamic random-access memories and automated radiation testing of ICs at the wafer stage. The first, by



Automated radiation testing. A simplified diagram of the model 4100 irradiation system shows its capability for wafer-level testing with X-ray, laser, and other radiation sources

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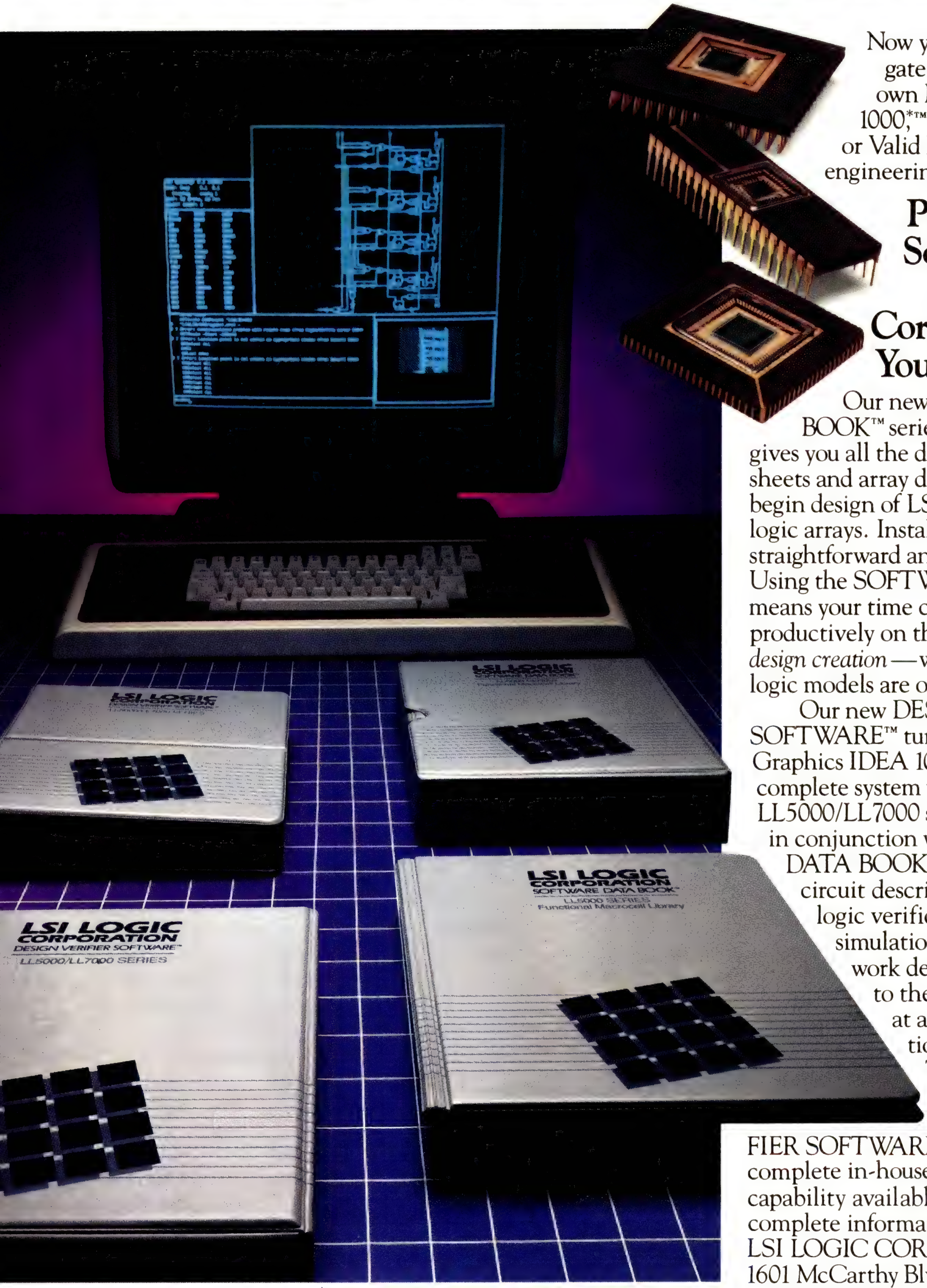

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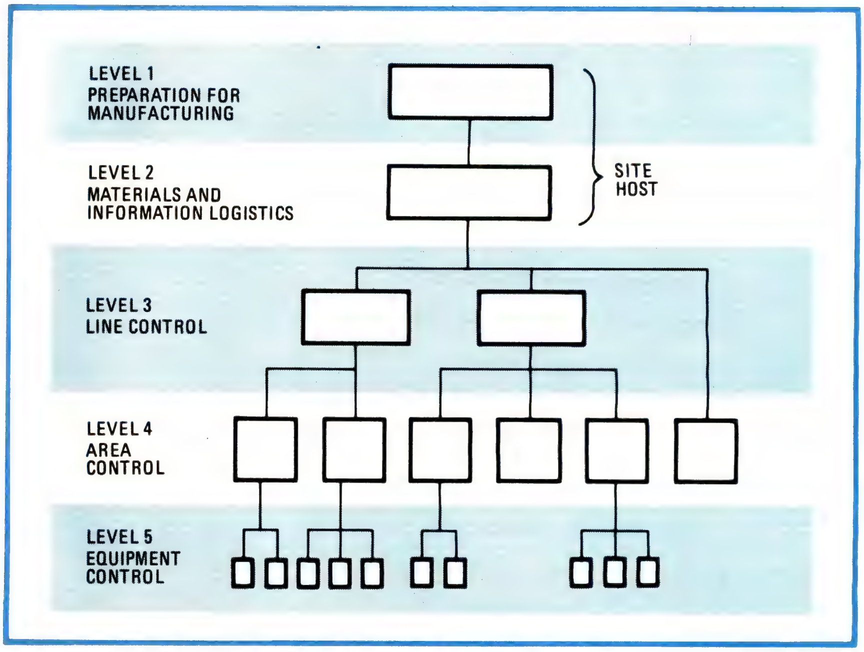
Donald M. Stewart, of Teradyne Inc., tells how the Boston, Mass., test-equipment maker is enjoying the economic benefits of using lasers to repair current-generation dynamic RAMs with redundant design. The pluses are twofold. First, the assets required to produce a given number of working parts are reduced, because laser repair can double the number of working parts from a front end, yet their cost is only one fifth that of adding equivalent front-end capacity. Second, volume can be ramped up rapidly without any need to wait for a new fabrication facility to come on line.

Stewart provides a statistical analysis of the repaired and unrepaired yield throughout the product life of a theoretical 1-Mb dynamic RAM. He calculates this at the start of the product's life and when it is mature as well. Early on, defect density will be high. In this case, the repair process increases yield to 50.9%, from 9.6%. When maturity arrives, the defect density could be much lower. In that case, yield improves to 82.5%, from 71.6%, when repairs are made by laser. A separate analysis by Stewart shows a payback period of 14 months or less for the equipment as the production of 1-Mb dynamic RAMs reaches maturity.

When it comes to automated radiation testing of ICs at the wafer stage, explains Leslie J. Palkuti of Advanced Research and Applications Corp., in Sunnyvale, Calif., the technique is needed to characterize the radiation responses of ICs at the wafer stage of fabrication. Palkuti's paper describes his company's model 4100 irradiation system (see figure), which is one of the first fully automated systems that can do the job. It can incorporate an X-ray source for total-dose simulation, an infrared laser for radiation-induced transient characterization, and a Californium 252 isotope source to simulate the soft errors produced by cosmic rays. Palkuti describes the system's implementation, including the characteristics of the simulation sources and the method of radiation dosimetry.

The instrument integrates the various radiation simulators with an automatic wafer prober and controller. Control is either manual or through an IEEE-488-bus interface connected to an external computer or to the controller. Irradiations can be performed during normal probe testing with high throughput and minimum interference.



Five tiers. At its East Fishkill, N. Y., facility, IBM uses this five-level hierarchically distributed system to support its automated semiconductor manufacturing. The system provides independent operation at each level and offers considerable flexibility for changes.

Rare peek. On the final day, attendees will get a glimpse into the closely guarded world of the computer-controlled IC fabrication plant. Representatives of International Business Machines Corp.'s East Fishkill, N. Y., facility will discuss the architecture of the information system that supports its semiconductor line. In addition, Fairchild Camera & Instrument Corp., Palo Alto, Calif., will reveal details of its Incyte (which is pronounced "in site" and stands for in-process, computer-aided, yield, tracking, and evaluation) automated system for semiconductor manufacturing.

The flow chart shows the latest IBM manufacturing-control systems architecture at East Fishkill. Level 5 provides real-time go/no-go feedback to the operator on the process. Level 4 provides sector visibility for the department manager, and level 3 offers visibility at the manufacturing line. Level 2 gives information at the plant or site itself, and level 1 provides the interface between engineering and manufacturing for numerical-control and test-data generation. Two hardware and software architectures are used, IBM System/370 Information Management System processors for levels 1 through 3, and Series 1 Event-Driven Executive for levels 4 and 5.

Fairchild's Incyte system provides manufacturing operations with the tools to improve product yield, throughput, and quality by tracking and controlling major elements of the semiconductor manufacturing and testing processes. An operational system consists of proprietary software and dual Digital Equipment Corp. VAX superminicomputers.

With Incyte, the wafers, lots, or electronic modules are tracked and monitored through each step of the manufacturing process. Sequence control is provided by directions for equipment operation, instructions, and process recipes that guide the operator. Alarm systems automatically place wafers, lots, or modules on hold upon detecting unacceptable deviations from standard process. Manufacturing engineering then evaluates such lots. Real-time process-control charts are used for statistical quality control. The system reviews measurement data in real time, and alarms provide an early warning of process drifts. □

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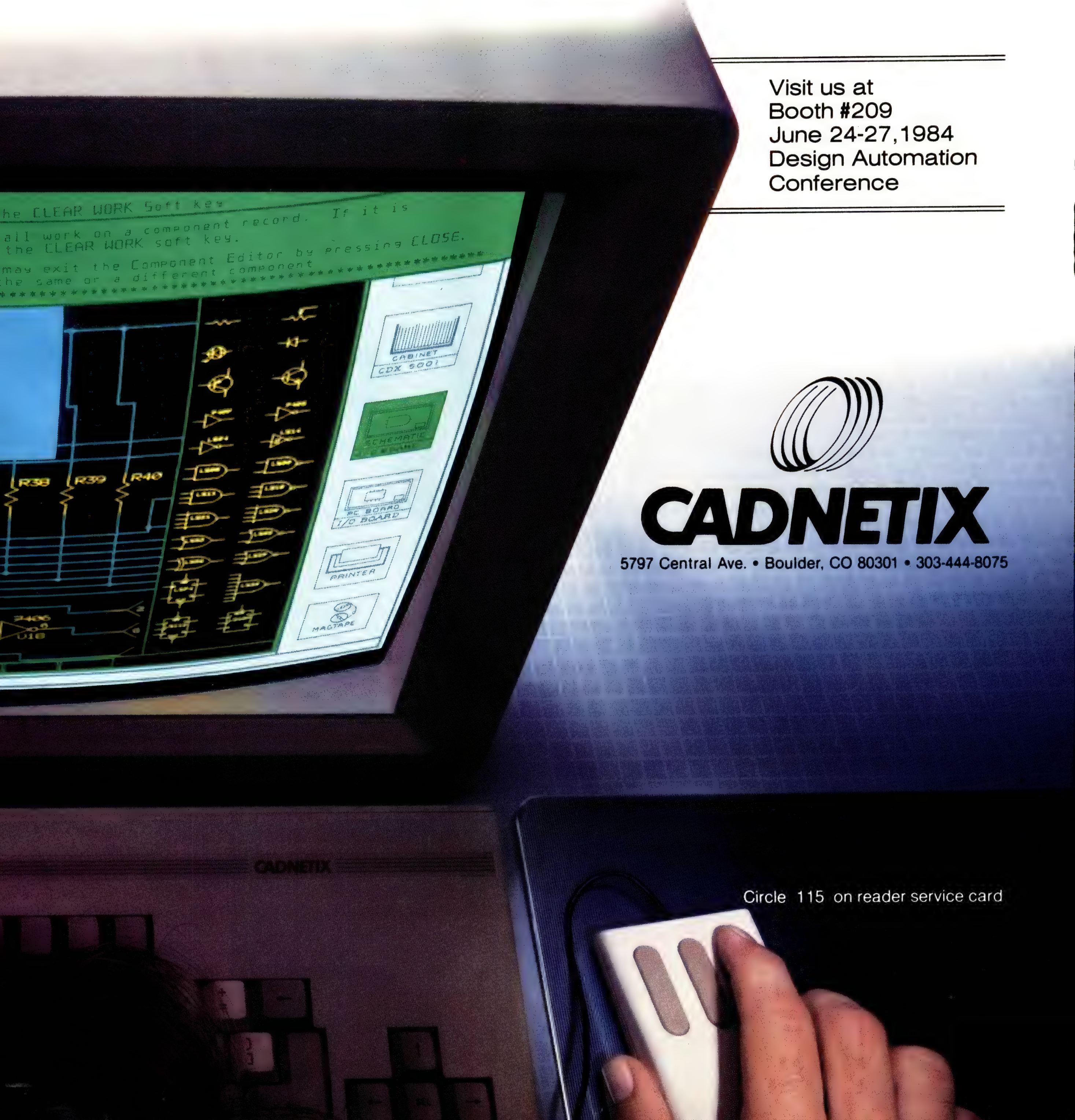

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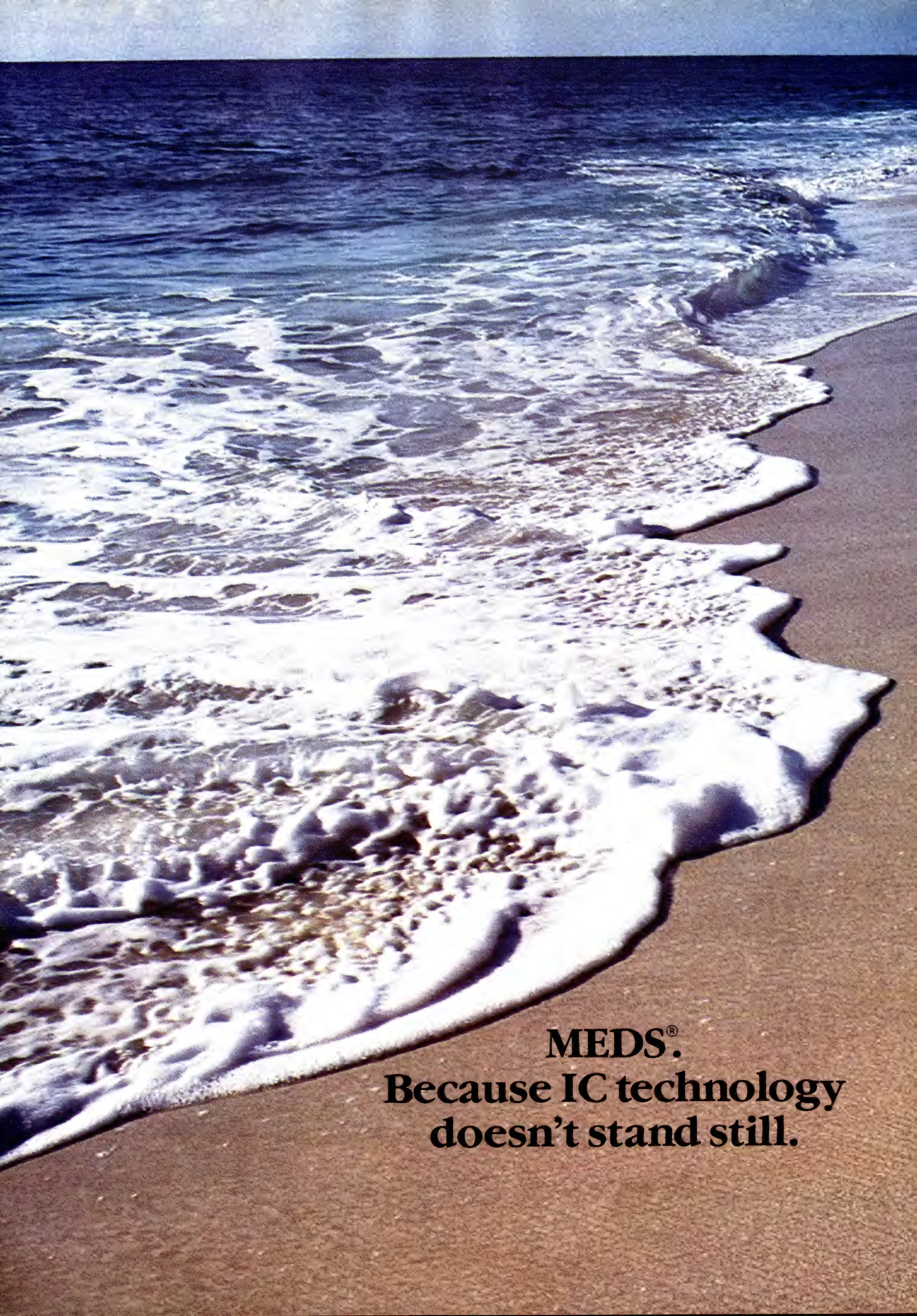
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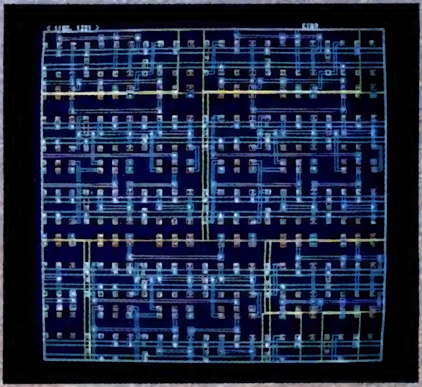

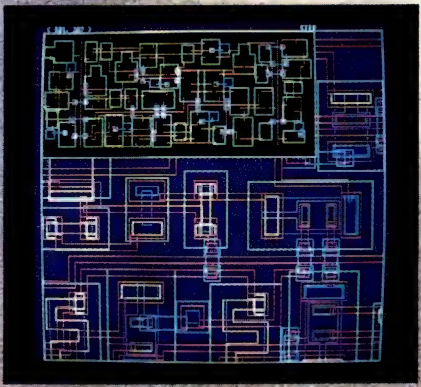

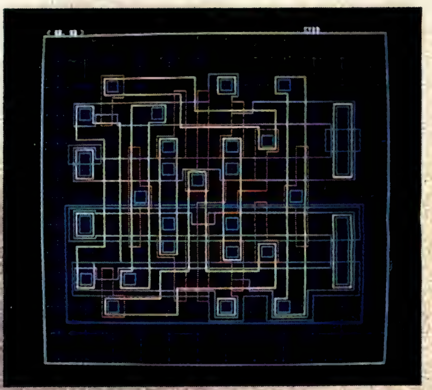

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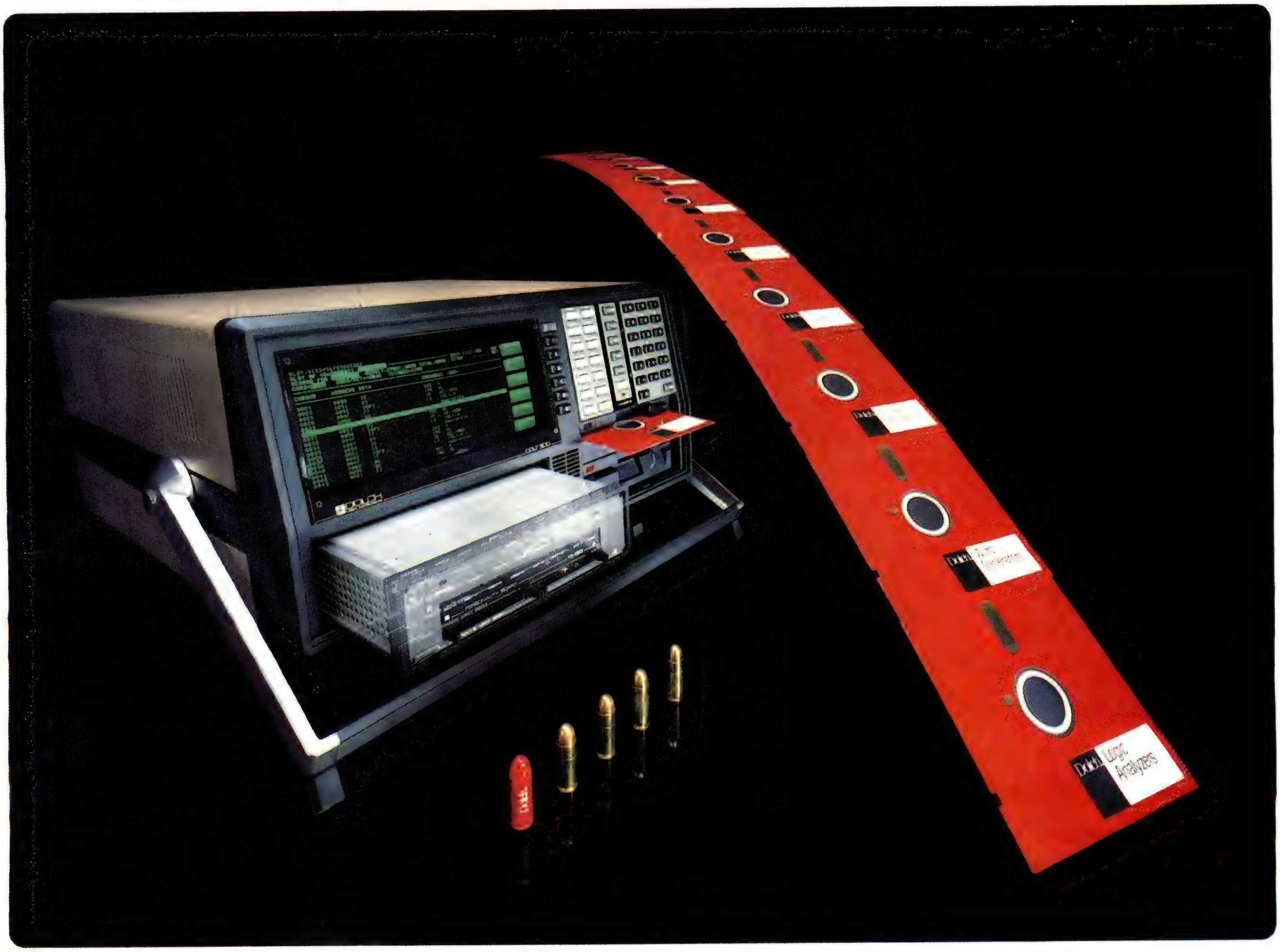

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SPECIAL REPORT: WORK STATIONS

Integrating the engineer's environment

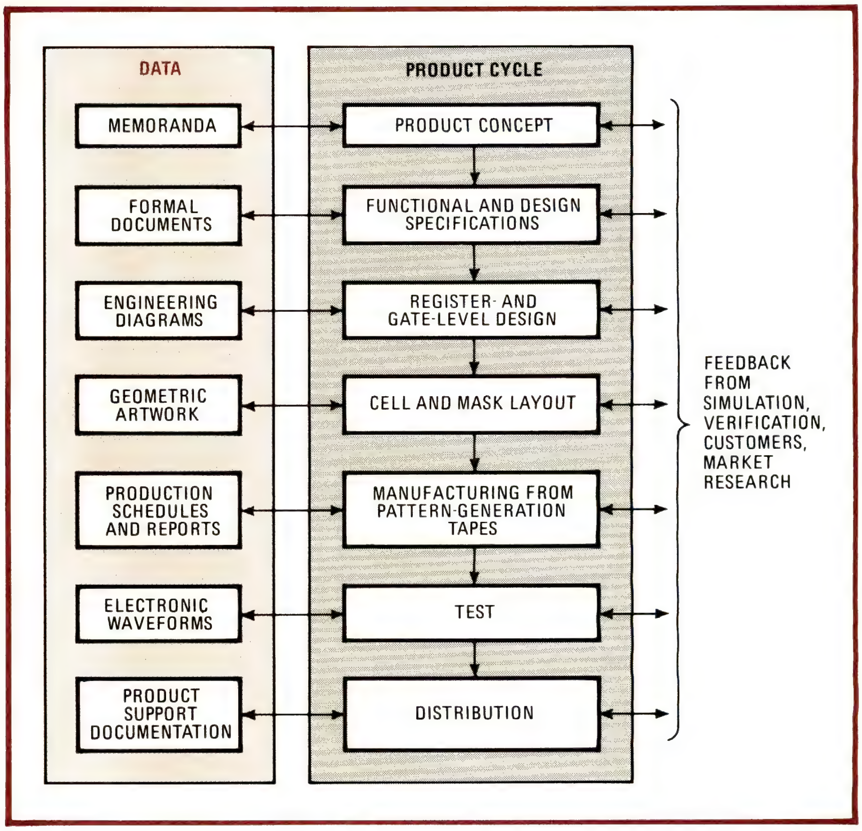
Powerful new computer-aided-engineering tools link system resources for higher productivity

by Stephen Evanczuk, *Contributing Editor*

☐ With the wide availability of both powerful microprocessor chips for simplified hardware development and design tools for the creation of new circuits, the electronics industry has cleared a critical barrier in its evolution. Now vendors can respond to specific application demands with dedicated chips and printed-circuit boards. Unfortunately for the vendor, however, one of the chief characteristics of this application-specific marketplace is its rapid turnover of products—allowing vendors little time to leverage the development of a particular product into a profitably long life cycle.

Caught between this diminishing product life cycle and a limited pool of engineering talent, the electronics industry is banking its future on high-performance desktop computers that can cut into lengthy design cycles and boost engineers' productivity. Driven by this demand, the two-year-old market for microprocessor-based stand-alone work stations will this year make its first major surge toward the $1 billion mark it expects to hit by the end of the decade. With the lead at stake in this fast-growing market, the current vendors of computer-aided-engineering work stations will compete in an expanded field as all major computer vendors—and a host of start-ups—trot out new entries.

Taking advantage of low-cost chips ranging from central-processing units to graphics processors, work-station vendors are striking a balance between price and performance with their stand-alone systems. Their introduction of this powerful form of local computing gives processing power to individuals without forcing a major investment in mainframe or minicomputer systems. Nonetheless, fitting one of these new systems into an established operation is not always easy. True, they give the engineer a means to improve productivity by providing the tools that can take a product from concept through test—all at a single station. But to the manager responsible for integrating these systems in an overall corporate strategy, they represent yet another variable in the equation that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1. Information management. An ideal integrated engineering environment accounts for every phase in the product cycle, as well as all possible feedback loops. The environment must also handle multiple forms of documentation associated with each phase.

balances corporate needs with available computing power.

Part of the complexity of establishing the specifications for a work station that settles comfortably into the engineering environment stems from the different aspects of that environment. On one hand, engineers must cope with the multiple facets of a design cycle that may last from concept to production. On the other, managers must be able to embed information about the product being created within a larger corporate organization that typically includes mainframes and minicomputers. Consequently, integration—both logical and physical—is the paramount work-station specification.

In the typical design cycle, products pass from concept through functional and design specifications to production and distribution (Fig. 1). Simply by collecting the diverse types of application programs into a single location, an integrated environment can boost productivity by eliminating wasted effort and errors introduced in transferring data between different stages of the design cycle.

A tightly integrated engineering environment, however, creates a synergy that further boosts the quality of the final product. For example, design-simulation results can be used as test vectors for completed products. Similarly, as designers reach later stages in the design cycle, they can build on the skeletal information contained in preliminary design specifications to create detailed product manuals. Thus, besides arming an individual user with a broad range of tools to forge the design, work stations connected through networks bring a wider view of product development to individual designers and managers.

Computing resources

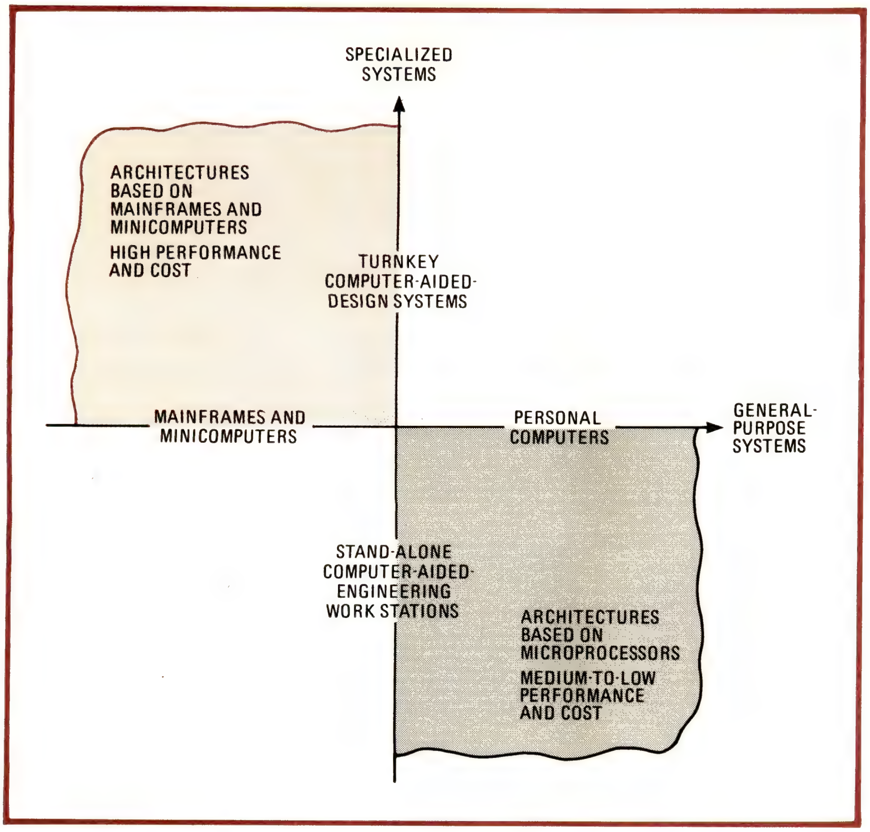
Despite the promise of shorter time-to-market and higher productivity, companies sometimes meet obstacles in adjusting to CAE work stations. Of the small company looking to gain an edge through CAE tools, Leonid Lipchin of Arthur D. Little Inc., Cambridge, Mass., says, "Venture capitalists don't always understand why a company wants to budget automation tools." Lipchin adds that even if start-ups manage to bring a product to market without automated tools, "they can't do the second-generation product in as short a time as is needed." For established organizations, although microprocessor-based systems can augment the computing resources available, they have nevertheless left managers wondering just where these systems fit into an overall corporate strategy. Says John Reed, vice president and general manager of Tektronix Inc.'s Information Display division, in Wilsonville, Ore.: "How to allocate processor power is the biggest problem."

For years, corporations have relied on mainframes and minicomputers for general computing and on dedicated minicomputer-based turnkey systems for special applications. Running application programs developed by third-party vendors, general-purpose mainframes and minicomputers have performed yeoman service for engineering efforts in the design of chips and boards—particularly in circuit simulation using programs such as Spice. Closer to the production side of the product cycle, turnkey systems such as those offered by Computervision, Applicon, and Calma have become standard drafting tools in the physical layout of ICs and pc boards. Powerful microprocessor chips have disturbed this neatly partitioned market, though, by creating similar systems at the low end for general-purpose applications—personal computers—and for particular applications—engineering work stations (Fig. 2).

Open door

The lack of response by the traditional system and turnkey vendors to the microprocessor left the door open for work-station start-ups to pull themselves up to their present level of market credibility. Only relatively recently have traditional vendors begun to explore this new marketplace—often by transporting their software packages to hardware from one of the vendors of general-purpose work stations.

Besides an array of sophisticated software offerings, the technology of this market revolves around stand-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STAND-ALONE COMPUTER-AIDED-ENGINEERING WORK STATIONS
ARCHITECTURES BASED ON MICROPROCESSORS
MEDIUM-TO-LOW PERFORMANCE AND COST

2. Configuration map. For creating an integrated engineering environment, managers can draw on general-purpose systems, as well as on such vertically oriented systems as turnkey computer-aided-design systems and computer-aided-engineering work stations.

alone high-resolution-graphics work stations based on one of the popular microprocessor chips. The strategic approach to this market, however, falls into two major camps. On one hand, original-equipment manufacturers such as Daisy, Valid, and Metheus develop both hardware and software that are targeted specifically for the CAE marketplace.

Alternatively, value-added dealers couple a general-purpose engineering work station with third-party software and thereby provide an integrated engineering environment. For example, Mentor Graphics draws on Apollo Computer's DN series of work stations to form its own CAE product line.

Finally, however, the market is feeling the first signs of movement from vendors of mainframes and minicomputers, turnkey systems, and personal computers. For example, among American Telephone & Telegraph Co.'s first set of 3B20 series processors targeted for the minicomputer market, the New York company included an entry, 3B2/300, at the price and performance level of an engineering work station [*Electronics,* April 5, p. 48].

At the end of March of this year, CAD vendor Applicon began shipping its own version of a low-cost work station. In addition, software vendors targeting the personal computer market—particularly IBM's Personal Computer—are making a move toward the CAE environment. Of course, this latter group will find itself competing more directly with value-added dealers such as Mentor as the next generation of 32-bit microprocessor chips enters production and further blurs the boundary between personal computers and personal work stations.

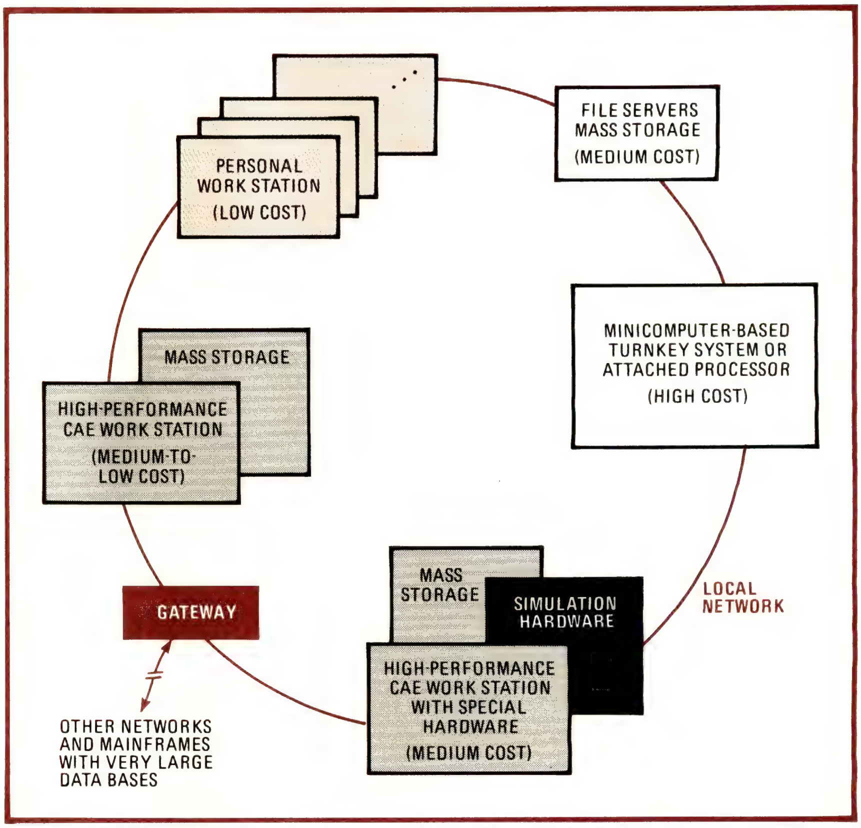
As early as next month, at the Design Automation Conference in Albuquerque, N. M., the list of players will expand to hold every major vendor in the computer industry, including graphics heavyweight Tektronix and CAD leader Computervision Corp. Announcements from these diverse vendors presage the eventual migration from other computational environments toward that offered by the work station. But few vendors argue that those arenas will disappear. For example, Tektronix' John Reed sees some type of large host in the future work-station system to serve as a central data-base resource and to unify the disparate capabilities of the system's different elements.

Current work-station vendors themselves expect their systems will cooperate with larger resources. Edward J. Zander, vice president of marketing at Apollo Computer Inc., Chelmsford, Mass., adds that "there will still be large machines somewhere in the facility storing a large data base or doing large complex computational processing." Similarly, turnkey vendors find a place for the personal computer. For example, Robert F. Kuhling Jr., director of marketing and market development at Calma Co., Santa Clara, Calif., notes that designers do not need the full capability of CAE work stations for schematic capture and that, in fact, Calma has been looking closely at schematic-capture tools on personal computers.

Consequently, gauging the capabilities of the different types of machines described below, system integrators can expect to deal with a variety of systems of different cost and performance—ranging from low-cost personal machines and dedicated machines to mainframes (Fig 3). In fact, machines at each level of capability will find a place in an organization's network of processing power. This mixture of computing resources should become more pronounced as the price barriers between different levels of system hardware drop (Fig. 4).

The market

Market analysts and vendors agree that the CAE-work-station market attracting this extensive list of vendors boasts enormous potential. Unlike other industries, the electronics industry depends critically on computer aids in the design and production of its products. In fact, according to a recent survey by Arthur D. Little, the electronics industry expects to double its use of computer-aided design and manufacturing from 40% to 80% within five years. In addition to feeding traditional CAD systems, CAE work stations are expected to grow extensively on their own.


PERSONAL WORK STATION (LOW COST)
FILE SERVERS MASS STORAGE (MEDIUM COST)
MINICOMPUTER-BASED TURNKEY SYSTEM OR ATTACHED PROCESSOR (HIGH COST)
MASS STORAGE
HIGH-PERFORMANCE CAE WORK STATION (MEDIUM-TO-LOW COST)
LOCAL NETWORK
MASS STORAGE
SIMULATION HARDWARE
HIGH-PERFORMANCE CAE WORK STATION WITH SPECIAL HARDWARE (MEDIUM COST)
GATEWAY
OTHER NETWORKS AND MAINFRAMES WITH VERY LARGE DATA BASES

3. Varied resources. Engineering environments are migrating to heterogeneous collections of systems. Low-cost personal work stations (tinted) are a missing piece likely to be readily available with the production of 32-bit microprocessor chips.

Though potential customers carefully sampled the offerings of a variety of vendors in the last two years, analysts say that 1984 should prove to be the first year that single sales multiply into major purchases. Eyeing this kind of momentum, Strategic Inc., San Jose, Calif., projects a market topping $500 million in four years, possibly exceeding $1 billion by the end of the decade.

With the economic recovery translating into heightened demand for chips and a number of major silicon houses completing system-qualification periods this year, a shortage of engineering work stations seems imminent, thinks Dave Niehaus, product manager for the Tegastation work station at Calma's recently acquired Austin, Texas, branch. "There will likely be a tremendous upsurge in demand in 1985 and 1986 after all the people complete the evaluation stage," he predicts.

Philip Monego, president of Paragon Technology Corp., Pleasant Hill, Calif., which entered the work-station market with its 300 series only last February, agrees that "the demand is extremely large. The whole architectural concept of being able to place a work station in front of an individual engineer is appealing, and a large number of companies are able to participate." Still, Monego thinks that work-station vendors have been carefully targeting this marketplace all along and will not likely be caught short. In fact, the rapid acceptance of these products brings an extra benefit to new firms needing capital but trying to avoid the clutches of venture-capital firms. Monego notes that the demand has permitted Paragon, for example, to sidestep extensive involvement with venture-capital funding and grow on the product's revenues as well as internally generated funds.

The vendors

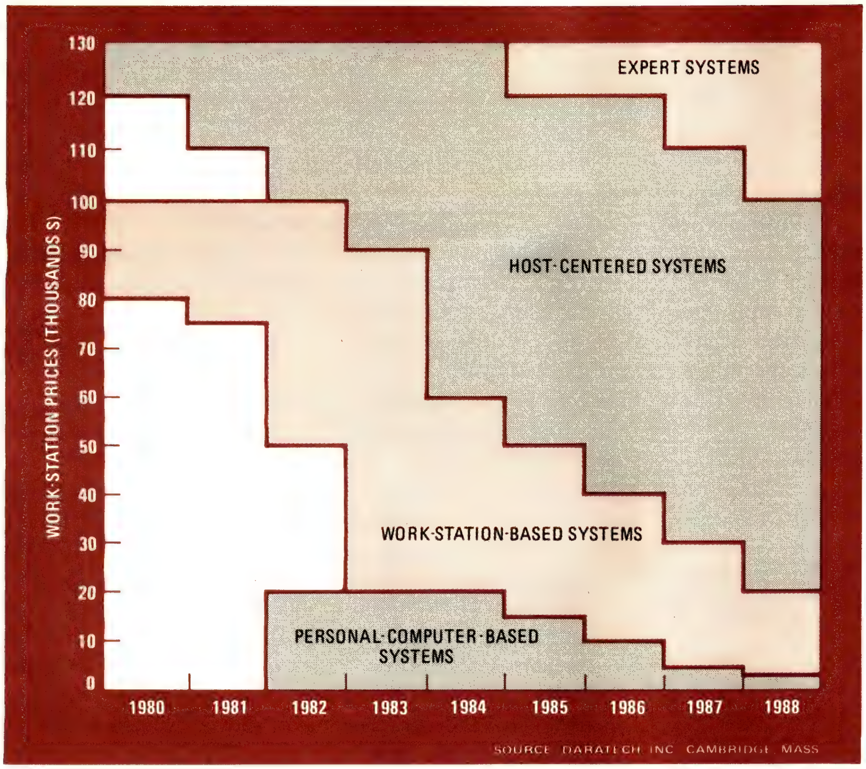
As they build their own CAE environments, potential work-station customers find vendors falling into a broad spectrum—from pure software companies that supply programs for a variety of hardware environments, to pure hardware companies that concentrate on major markets and look to independent software vendors to supply tools. Between these two extremes, a great many companies supplement their offerings by adding the complementary technology to their main lines of business.

For example, to provide a wider distribution of its Tegas simulation software, Calma's Austin operation is offering both stand-alone work stations—in the form of the Apollo-based Tegastation—and Tegas software packages for minicomputers and mainframes. By offering compatible features in its stand-alone stations and Tegas host software, Calma believes its customers will be able to mix networked work stations and large computers in the most flexible way possible.

Although the number and variety of vendors is growing rapidly, four work-station vendors managed to capture more than 80% of the CAE marketplace in 1983 (Fig. 5), either by building on their own hardware or by acting as value-added dealers for another OEM's hardware. To all appearances, CAE vendors' work stations are indistinguishable from a host of similar stand-alone desktop work stations for general-purpose applications ranging from software development to graphics design.

The details of the architecture might vary—along with which central processing unit the vendor adopts—but the typical work station includes extensive system memory, mass storage, a graphics subsystem, a mouse input device, and communications subsystems (Fig. 6). Mouse-driven multiwindow interfaces also play a large role in CAE environments by permitting engineers to examine several aspects of a design at once (Fig. 7). Some CAE vendors, however, are beginning to differentiate their hardware by adding dedicated subsystems for direct hardware support of circuit simulation—a critical phase of the design process.

CAE work-station manufacturers, like their counterparts who build general-purpose engineering work stations, have drafted a variety of designs for their CPUs. Several vendors—both oldtimers such as Versatec and Apollo as well as newcomers such as RNA Inc., Pleasanton, Calif.—have launched systems based on bit-slice im-



SOURCE DARATECH INC CAMBRIDGE MASS

4. Pricing trends. Although the cost of software for integrated engineering environments will vary depending on the application, hardware prices will drop. This should prompt a greater mixture of computing resources of different capabilities.

plementations of the central processor. For the most part, however, vendors rely on off-the-shelf CPUs.

Motorola's 68000 series CPU has won acceptance, primarily for its similarity to Digital Equipment Corp.'s VAX—the de facto standard engineering tool. In fact, not willing to wait for Motorola's 32-bit version, the 68020, Apollo designed a bit-slice processor that fully emulates the 68020.

Daisy will soon find an increasing number of vendors—possibly including IBM—joining it in its use of Intel's 80286 microprocessor. Designed specifically for the type of multitasking environment encountered in CAE, Intel packed the chip with hardware support for task switching, virtual addressing, and memory management and protection.

In addition, the market can expect to hear from National's 16032 series of microprocessors. Widely considered the most "VAX-like," National's chips should attract vendors looking to capture some of the VAX—and Unix—market. National has already claimed first bragging rights in the 32-bit market with the release of its 32032, which features external paths 32 and 24 bits wide for data and address, respectively.

Software battle

Because of the relative ease of creating microprocessor-based designs and the availability of a growing base of increasingly sophisticated application software, even more vendors will be drawn to this market. For instance, relatively new work-station vendors, such as Paragon, trace much of their success to the availability of software. Paragon's Monego says that his company's close relationship with a Swiss software company, Electronic Industrial Systems S. A., let it avoid a costly research and development phase. He explains that Paragon had to develop just its hardware, based on DEC's LSI-11/73, rather than also develop the software, which he says is much more significant. For Daisy Systems Corp., Sunnyvale, Calif., which develops its own hardware and software, "Hardware is easy. The fact that there are more than 100 machines today is not because designers are smarter but because it's easier," says Lucio Lanza, vice president of product marketing. "What's important is selling an environment, not just hardware."

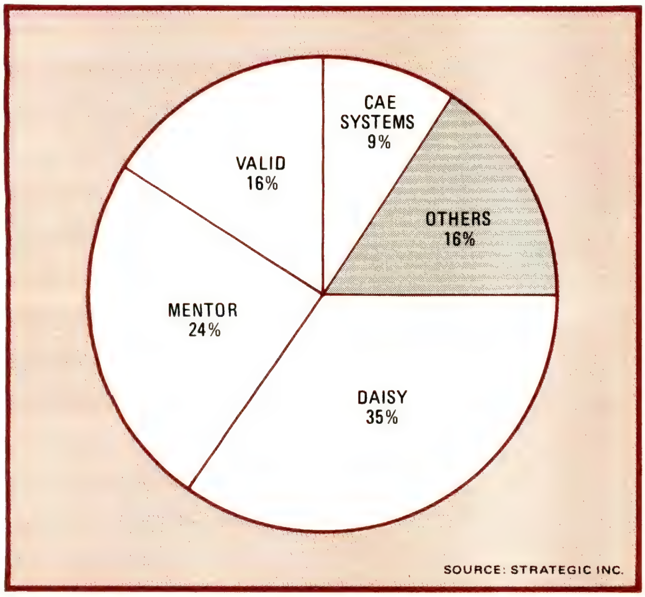
Consequently, behind the more evident battles that pit various system hardware configurations against one another, CAE vendors are continually trying to outflank their rivals with software offerings that cover the entire design and production process (Fig. 8). Some vendors are even exploring how to apply techniques from artificial intelligence to the work-station environment (see "Computer-aided engineering wises up," p. 129).

As software assumes a greater role in this market, in-house software developers such as Daisy, Valid, and Metheus are finding themselves pitted against software houses such as Silvar-Lisco and design houses such as LSI Logic, which license their design tools. Silvar-Lisco's tools, which span the design process—from functional design to placing and routing of gate arrays, standard cells, and pc boards—also span a variety of hardware bases, including IBM mainframes, DEC VAX machines, Prime minicomputers, and stand-alone Apollo work stations. Since the beginning of this year, LSI Logic has made its proprietary design tools—developed on mainframes—available for Mentor, Daisy, and Valid work stations.

Still, notes Stephen H. Perry, practice leader for CAD in Arthur D. Little's computer-integrated-manufacturing section, all these systems must work off a common data base. Cadtec Corp., San Jose, Calif., agrees and offers its own solution—a set of interfacing software packages that free the user from the vagaries of different application packages and uncouple the application packages from the peculiarities of a central data base [*Electronics*, May 19, 1983, p. 127]. Stephen C. Schopback, vice president of marketing, says that the system's standardized interfaces handle all the low-level communications between 68000-based work stations and a VAX host, so that the user does not have to cope with two different environments.

CAE Systems Inc., Sunnyvale, Calif., is also chasing the combined work-station and minicomputer market with its trademarked CAE Worksystem. This package runs both on Apollo and VAX equipment to provide designers with a loosely coupled distributed set of tools and a data base. Ashok Suri, vice president of engineering, notes that designers need an environment that automatically integrates the various components of a large design. CAE Systems' data-base manager automatically constructs a tree structure whose nodes (references to various hierarchical structures in an overall design) point to substructures and ultimately to the leaves—the data itself. Suri says that for the design of a large integrated circuit such as a CPU, engineers can use the data-base manager to specify a logical tree that corresponds to the components of the physical device. For example, the tree would branch from a top-level description that splits the microprocessor into major components down to low-level detail of how individual gates are wired together.

Software vendors such as Cadtec and CAE Systems should find more competition in the next year as more system vendors appear with sophisticated distributed architectures. Apollo's network-wide virtual-memory system has recently met with competition from Perq Systems Corp., Pittsburgh, Pa. Based on Accent—a distributed operating system designed in cooperation with Carnegie-Mellon University, in Pittsburgh—Perq work stations communicate over a proprietary network called Linq. In another approach, Sun Microsystems, Santa Clara, Calif., built networking features into its version of AT&T Bell Laboratories' Unix operating system. These features, developed by the firm's software director, Bill Joy, should key major developments in resource and data sharing between Sun work stations.



SOURCE: STRATEGIC INC.

5. Open door. In 1983, four vendors together captured more than 80% of the market for CAE work stations. As 1984 brings more volume sales, the market stands to open up to established vendors and start-ups.

Veteran vendors

Still, these systems will have to contend with pressure from established vendors. Such giants as IBM with its 5080 graphics work station and AT&T with its 3B2/300 will stand to attract a major share of software vendors to their hardware. In addition, DEC's PDP11/73 and micro-VAX should boost the Maynard, Mass., company into a major position in the work-station market—filled with an existing base of DEC users, particularly its large VAX following.

Referring to IBM-compatible graphics work stations such as the Adage 4250, Richard N. Spann, president of Adage Inc., Billerica, Mass., says, "The driving function [for IBM-compatible graphics work stations] has little to do with hardware specs—it has to do with the fact that they're used by Cadam [a CAD/CAM software package running on IBM mainframes]. They're pulled into the market by application software. They're not pushed in by their hardware capability."

In this traditional mainframe arena, vendors such as Adage and CGX Corp., Acton, Mass., offer high-performance graphics hardware to display data manipulated by an IBM mainframe. At this level, managers already find a growing set of configuration options that further cut the gap between these systems and CAE work stations. For example, each IBM 5080 graphics work station runs off a dedicated display controller, unlike more traditional clustered systems, where a number of stations share a high-performance display controller. CGX went a step further and dropped this controller into the work station itself in its 5080-compatible System 2001.

Although James C. Nitz, vice president of marketing at CGX, does not think the move is imminent, he notes that IBM could complete the transformation of the 5080 into a stand-alone work station by beefing up the floor unit associated with each 5080.

In fact, the gap in capability between IBM's high-performance 5080 work station and its low-cost PC has created a market window for CAE work-station vendors. Still, CAE work-station vendors feel confident that their own share of the market will not dry up when IBM enters. In fact, Apollo's Lou Reynolds, product marketing manager, says, "IBM will legitimize this like they legitimized the personal computer, thus opening the door even wider for engineering-work-station vendors."

More vertically oriented companies traditionally associated with the CAD market are also pushing their own versions of work stations into this gap. Versatec, a Xerox subsidiary in Santa Clara, Calif., has capitalized on the technology that started the revolution in graphics-oriented multiwindow interfaces—the Xerox Star. In its Expert series, Versatec combines Xerox's 8010 work station with its own application software. Based on a proprietary bit-slice processor providing performance of about 1 million instructions per second, Expert work stations run in an Ethernet environment and provide a Star-like mouse-driven multiwindow interface.

CAD turnkey specialist Applicon Schlumberger, Burlington, Mass., also sees the personal work station as a lucrative market. At the end of March, Applicon began shipping its own desktop color work station, the 4620. According to the company's manager of system marketing, Jeffrey A. Simon, the floppy-disk option makes the system appear to customers to be a personal computer—it can even run CP/M 86.

Besides the veteran vendors, the personal computer is attracting newcomers to the CAE market. Personal CAD

Systems Inc.'s Roy Prasad, vice president for electronic design automation, says that machines such as IBM's PC are powerful enough for schematic entry, logic simulation, and pc-board layout—given the right software. Thus, such vendors as P-CAD, FutureNet, and Chancellor Computer key in on these less computation-intensive aspects of design. For example, P-CAD, Los Gatos, Calif., offers a set of three packages—built around a common data base—for each of these areas.

In addition, vendors in various vertical markets find personal computers an attractive low-cost stepping-stone toward more high-performance environments. For example, Norman Miller, executive vice president of Micro-Linear Corp., San Jose, Calif., says that though the cost of integrated systems can be justified, it is more difficult when the average designer is not familiar with the use of automated tools. Using the large number of IBM PCs usually available in any firm, engineers can gain experience with tools such as Micro-Linear's version of Spice on their personal computers. Eventually, Miller says, engineers can switch to larger CAE work stations, such as Daisy's, for more complex functions.

Simulation accelerators

CAE work-station vendors are not idly letting the competition take over. In fact, a recent flurry of leapfrogging marketing tactics found Valid and Daisy introducing specialized hardware for simulation. Designers use simulation, the heart of CAE, to check that a proposed design can fly. Says Daisy's Lanza, "You have to make sure that the iterative part of the design cycle is fast."

Introduced at the end of last year, Daisy's MegaLogician uses a special-purpose hardware subsystem to speed simulations. Although each of the three processors in the MegaLogician's simulator pipeline operates with a 100-nanosecond processor cycle, the simulation could develop a bottleneck during lengthy evaluations. To counter this, designers can attach more than a single evaluation unit to the MegaLogician simulator. Designers using one type of evaluation unit—Daisy's physical modeling extension—can plug the actual hardware into the simulation.

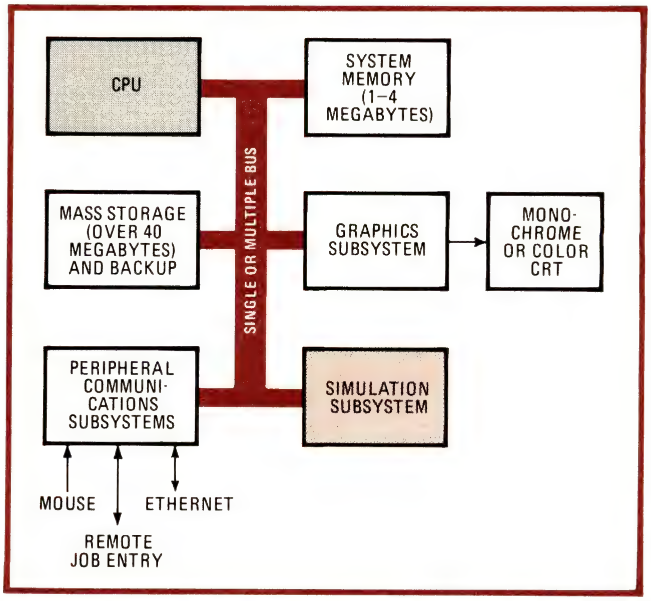
Similarly, Valid Logic Systems Inc., Mountain View, Calif., has responded with its own simulation hardware: Realfast and Realchip handle simulation of gate-level circuits and very large-scale ICs, respectively. Running on Valid's Scaldsystem, Realfast draws on a pair of dedicated processors to back simulation with hardware support. As with Daisy's PMX (physical modeling extension), designers using Valid stations can plug their actual chips into the simulation process by using Valid's Realchip.

Hardware-backed simulators such as the PMX and Realchip replace the designer's breadboard with an electronic analog, much as device-modeling programs such as Spice give designers insight into electrical processes without actually building the chip. However, unlike low-level device modeling—or simulation of relatively simple circuits—simulation of large-scale ICs, much less VLSI, is often impossible because a complete formal description usually does not exist or is not generally available. Furthermore, notes L. Curtis Widdoes, vice president and chief scientist at Valid, "even if, for example, Intel gave out a model of its 8086, it would run too slow on software simulators."

Instead, these new simulators replace a subroutine call to a software model with a set of procedures that apply input values to the actual chip and return the actual output values it produces—much as a subroutine call returns results. For example, Valid's Realchip uses a single reference model of the target chip. Realchip software handles all housekeeping, including restoring the internal state of the reference hardware prior to each call.

Specialized parts

In addition to dedicated hardware for simulation, vendors are turning to specialized architectures and even custom devices for other subsystems in CAE work stations. Masscomp, Westford, Mass., for one, defines its own bus for high-performance architecture. The company uses its high-speed bus for its performance-critical subsystems but supports a second bus—Intel's Multibus—for slower peripherals. With this structure, Masscomp can add auxiliary microprocessor-based subsystems to its basic design. For example, Masscomp recently announced support for a second graphics subsystem to share a single CPU. Masscomp's Rattan Dhar, CAE marketing manager, says that the second graphics subsystem adds little extra load to the CPU, so that two users can share a single system and get the same performance as a single user—but without incurring the cost of another complete system.



6. Sample architecture. Although the details of the architecture vary, simulation subsystems (tinted) are starting to appear in some vendors' offerings in addition to plenty of system memory, mass storage, and subsystems for graphics and communications.

Texas Instruments Inc., Dallas, also riding on its own bus structure, made its official entry into engineering work-station markets with its Nu Machine, introduced last January [*Electronics*, Jan. 12, p. 190]. TI believes the bus-centered architecture will prove most flexible in serving a wide range of applications—from architecture to IC design to offshore-drilling-rig design, says George P.

7. Various views. Driven by a mouse input device, computer-aided-engineering work stations typically offer graphics-oriented multiple-window interfaces. These enable the engineer to look over several aspects of the design at once.

White, Nu Machine development manager, in Irvine, Calif. "The key to our machine's flexibility is that it's bus-centered rather than CPU-centered, meaning that OEMs can design their own central processors much like they used to design their own disk controllers." For example, in an artificial-intelligence work station based on the Nu Machine, Lisp Machine Inc., Los Angeles, plays on the component-processor theme with its proprietary processor optimized for execution of Lisp—AI's de facto standard programming language.

Although the installed software base will demand compatible software interfaces, work stations will continue to sport special-purpose hardware for graphics and numerical processing. Already such systems as Masscomp's use one or more dedicated graphics subsystems to handle their high-speed color graphics and fast array processors to boost numerical processing. In addition, the new work stations themselves are sure to get a workout as more vendors create special chips for these applications.

One product, the Geometry Engine, from Silicon Graphics, Mountain View, Calif. [*Electronics,* October 20, 1983, p. 113], serves as an element in a matrix-processing pipeline—letting designers develop systems that can rotate shaded three-dimensional projections in real time. Special chips for numerical processing should help boost performance and cut costs. Besides chips from semiconductor houses that pair off with specific microprocessor chips, such independent vendors as Weitek Corp., Santa Clara, Calif., provide high-speed floating-point processing [*Electronics,* May 19, 1983, p. 121].

The users

Although the players in the work-station marketplace expect CAE work stations to serve as the basic glue of integrated engineering environments, users must still find their own methods to fit existing tools into their overall design strategy.

John R. Wallace, president of Ford Microelectronics Inc., in Colorado Springs, Colo., warns that companies shopping for a CAD work station must be prepared to tailor CAD packages to their own needs to get the system's full benefits. Wallace should know: for the past year, he and his operation have been creating a system aimed at giving Ford Motor Co.'s automotive and aerospace engineers the ability to design their own chips from standard-cell libraries. Ford's system uses Daisy work stations and a number of software packages that have been integrated to better suit the parent company's particular needs.

"We are not waiting around for the work-station guys to solve our problems," Wallace says. "You have to pick the [system] you want and go with it, but you also have to be ready to do your own work to get it where you want. . . . I've got chips being designed that will be 3 million runners for autos and lower-volume pieces for Class S space systems. I just cannot take what comes off the shelf [from CAD vendors] and use it." Currently, Ford has Daisy work stations located in its microelectronics facility and at plants in Dearborn, Mich.; Newport Beach and Palo Alto, Calif.; and Houston.

The degree of difficulty in adapting CAE work stations to a corporate data-processing and engineering policy is often less a problem in methodology than in logistics. In general, work-station customers have had difficulty communicating between different brands. Most CAE houses now rely on mainframes to mediate the transfer.

VLSI Technology Inc. of San Jose, Calif., has about 60 Apollo computers in place in various configurations, typically with one engineer per station. Steve Trimberger, VLSI's project leader in CAD software, has seen only one disadvantage in using the Apollo—translation programs must be written when the machines have to load information developed on another work station, such as a Mentor, Valid, or Daisy. Though an inconvenience, this

Computer-aided engineering wises up

One way to bolster productivity on a work station is to pack engineering application software with "small embedded expert systems" that automate daily tasks—such as design and layout rule checking, statistical design programs, database management, and even electronic-mail sorting. That, at least, is the thinking of leaders involved in Hewlett-Packard Co.'s Prism project.

"For almost every application that exists today you could ask yourself, 'Where could knowledge-based approaches help?' " suggests Roger E. Ison, who is heading the efforts at the Fort Collins, Colo., division to apply knowledge- and rule-based programming techniques to HP's desktop work-station products. "We believe the most productive use of artificial intelligence will come through knowledge-engineering approaches embedded in the types of packages being used by people today."

To do that, HP is working from its base of common programming languages, local networks, distributed computing architecture, and Unix III-like HP-UX operating-system software for its series 9000 computers. HP is now running knowledge-based–enhanced application programs in-house on its standard 16-bit 68000-based work stations.

Keeping the scope of the rule-based program small will make it easier to integrate into existing software packages and run on today's hardware, Ison thinks. A small embedded knowledge-based system, for example, could be integrated into an electronic-mail package to allow the user to set rules to have the software automatically sort mail. "The emphasis will be to make it easier for the user to set the computer up to do exactly what he wants," says Ison. "In some sense, the computer has been like a slave or servant. This will allow users to treat the computer work station as an employee, telling it less and having it know more about problem solving." **—J. Robert Lineback**

necessity has posed no obstacle, says Trimberger.

LSI Logic, on the other hand, found its own solution to the problem of transferring information among its Mentor, Daisy, and Valid work stations. In connecting the work stations, the Milpitas, Calif., firm found that Ethernet and Apollo's Domain network were equally easy to work with; however, the company had the advantage of its mainframes. Perry comments, "I pity the guy who doesn't have a $10 million computer. Without it, he has a hell of a time getting different brands to talk to each other."

On the other hand, NCR Corp.'s Microelectronics division, in Colorado Springs, had little problem transferring data among its turnkey CAD systems, minicomputers,

CAE work stations redefine productivity

In expanding individual perceptions of the product cycle, work stations force a concomitant reappraisal of how managers measure the benefits of these machines—and thus justify the capital investment. Unlike their counterparts in data-processing departments, who can point to specific benchmarks of performance, individuals looking to purchase computer-aided-engineering work stations can only couch their justifications in terms of a more elusive standard—productivity. Still, in examining a work station's impact on an engineer's productivity, managers cannot myopically focus on limited aspects of the design cycle.

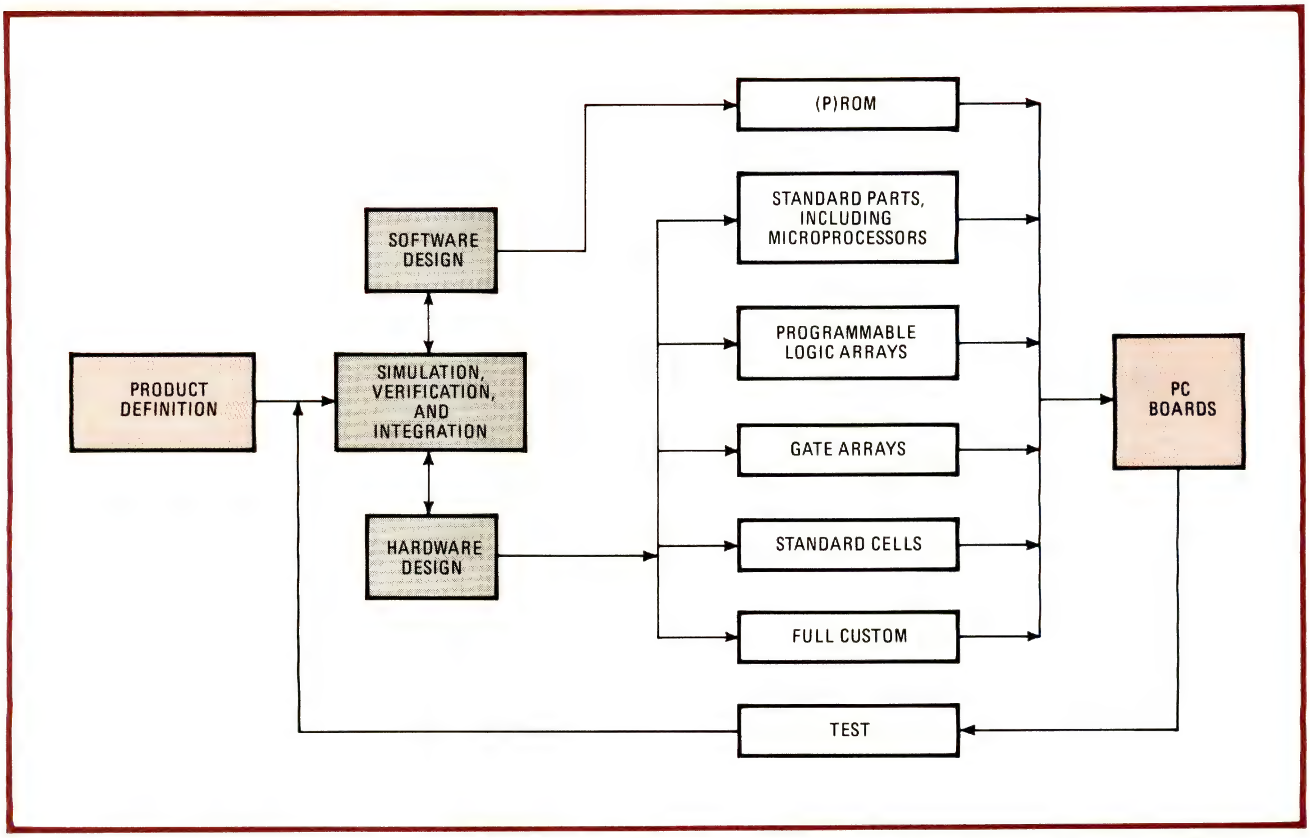
Daniel J. Borda, a senior member of the computer-aided-design practice of the computer-integrated-manufacturing group at Arthur D. Little Inc., Cambridge, Mass., observes that in establishing a baseline for measuring productivity, managers should not attach undue significance to, say, the engineering phase but should carefully assess the entire product cycle. For example, referring to experiences in highly engineered low-volume products such as aircraft, Borda notes that although the biggest potential for cost saving occurs during the design phase, manpower requirements actually rise afterward, when scores of draftspeople enter the scene to convert concepts to drawings.

Therefore, although automated tools can boost the productivity—or the drafting speed—of an individual draftsperson, they "could simply be producing a bad design faster," says Borda. He adds that here the real key to producing a superior product in an efficient manner is to "dump dollars on the six or so engineers engaged in the design phase."

Even in high-volume markets in the electronics industry, an analogous situation arises: scarce engineering talent must be unharnessed to produce high-quality designs as efficiently as possible. Lucio Lanza, vice president of product marketing at Daisy Systems Corp., Sunnyvale, Calif., notes that integrated-circuit designers labor under the pressure of knowing that each mistake costs about three months in market lead time—a heavy penalty in the highly competitive semiconductor industry.

Still, Lanza adds, though the perception of a mistake's cost is lower among system designers—whose numbers are a hundredfold greater—the reality is the same. Although the electronics industry commonly accepts an integrated-circuit designer's need for automated tools, the increasing use of multilayer printed-circuit boards is also turning CAE into a necessity for system designers. With CAE, engineers can debug a design while it is still represented in software, before it is cast in silicon or committed to pc boards, where mistakes are more costly and take longer to correct.

Still, improving productivity in the engineering environment means more than helping engineers build chips and boards faster. Industry observers comment that engineers spend only about 30% of their time on design work. Conventional office work and meetings account for the remainder. Consequently, CAE vendors will find themselves hosting more general-purpose software packages such as those for word processing and spreadsheets.


(P)ROM
STANDARD PARTS, INCLUDING MICROPROCESSORS
SOFTWARE DESIGN
PROGRAMMABLE LOGIC ARRAYS
PRODUCT DEFINITION
SIMULATION, VERIFICATION, AND INTEGRATION
PC BOARDS
GATE ARRAYS
HARDWARE DESIGN
STANDARD CELLS
FULL CUSTOM
TEST

8. Design cycle. In a computer-aided-engineering environment, designers hope to shorten the time between product definition and the creation of the final printed-circuit boards containing the product (both tinted) with software that can cover both design and production.

and work stations. According to Tom Miller, director of VLSI processor products, the company designed its 32-bit NCR/32 chip set on Calma equipment but has migrated to Daisy work stations and is doing its current releases on that equipment.

In attempting to measure the productivity gain of CAE work stations, managers can find themselves looking closely at the definition of productivity (see "CAE work stations redefine productivity," p. 129). Nevertheless, Hewlett-Packard Inc.'s systems technology operation, in Fort Collins, Colo.—which works on in-house chip design—has found that networked desktop stations offer measurable benefits. An internal study of productivity shows that in 1981, HP chip designers—using work stations tied to a mainframe host—were averaging 12 correct transistors per day.

Still, HP's VLSI-design methodology, which splits IC layout into smaller pieces, more than doubled the industry's average of two to five correct transistors per day, says Linda Beauvais, product manager in the HP 32-bit work-station group. HP arrives at this figure by dividing the total number of transistors on a chip by the number of days needed to create it. Limited design and capture functions were performed on the work station, but analysis and simulation were piped to HP 3000 and Amdahl computers 25 miles away, in Loveland, Colo.

In 1983, chip designers were working on 16- and 32-bit stand-alone work stations, all linked through shared resource-manager clusters. Productivity jumped to 54 correct transistors per day, compared with the industry's standard of 5 to 12, the study says. With the power of 32-bit MOS III chips inside HP 9000 systems, engineers were able to locally execute analysis and simulation programs on work stations. The design of a new memory-controller IC last year was 100% correct on the first pass after the shared-resource-manager network was in place.

The network and stand-alone stations result in faster response times, so that design engineers see results much more quickly, says Beauvais, adding that designers were also more likely to double-check their work and send messages to co-workers on ways to improve and shorten development time. In bypassing the mainframe for intensive design analysis and simulation computations, HP officials in Fort Collins say, they were able to save an estimated $1,000 per day—a total of $280,000—during the memory controller's design.

Training classes

As more organizations turn to CAE work stations and accept the associated design methodology and working environment, training will earn more attention from managers concerned with effecting a rapid switch to the new machines. At last March's Design Engineering Show, in Chicago, Miland Meek, the manager of operations and services for 3M Co. in St. Paul, Minn., remarked during a session on user experiences with automated tools that "there's no such thing as a turnkey system. The final responsibility falls on the owner of the system. . . . Training will be your most important responsibility. . . . The vendor will train you how to use the system, but your staff will have to develop the methodology of how to run your business." ☐

DATA BASE

The coming surge in data-base systems

Relational data-bases, in particular, are now integrating personal-productivity applications on computers of all sizes

by Tom Manuel, *Senior Editor, Information Systems*

☐ People who have trouble remembering important information and dread the effort of retrieving it from filing cabinets or computer systems would surely like to have a personal assistant with a photographic memory. For although the human brain is ordinarily good at associative memory recall, it is not always reliable and in general does not work well with very large data bases. Most people would jump at the chance to avail themselves of "Star Trek's" Mr. Spock, with his gift of perfect recall. And while we're on the subject, it would certainly be nice to have instant access to any information at all.

Such fantasies may soon be quite real. Cheap but powerful 16- and 32-bit personal computers, networks of large computers, and effective links between personal computers and mainframes could make the dream of instant access to information come true. The hardware is available. The necessary software technologies—data-base systems, application builders that do not require programming, natural-language user interfaces, and high-level communications protocols—are starting to show up and to become efficient.

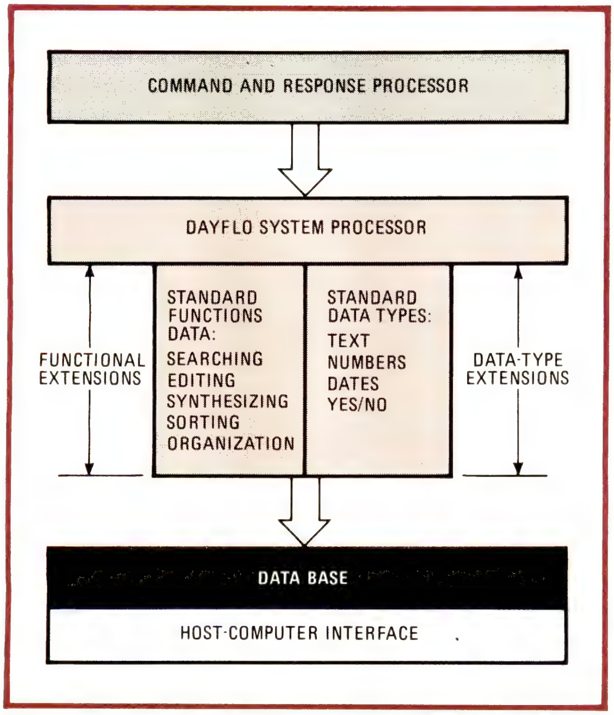
This special report will focus on data-base systems and the wide range of user interfaces and application-development aids that work with them. (The next issue of *Electronics* will have a report on high-level communications protocols.) Besides the data bases and the data-base managers, the systems covered here include interactive query languages, application builders, natural-language interfaces, report writers, and integrated-application packages.

Data-base systems are becoming very important for the kinds of information applications that virtually all professional people need. Most of the developed world's industries are becoming information-intensive. Better information-handling technologies give the companies that use them a competitive advantage.

The advent of relatively cheap desktop machines has already given office-based workers much greater access to computers. Now new kinds of software—especially data-base systems, unstructured interfaces, application builders, integrated packages, and networking programs—are about to increase it even more.

A third kick for computer use will come from cheap and easy-to-use links among personal computers, corporate mainframes, and external information services. These links, which are needed to make personal computers really productive in the office, must involve more than just communications links and protocols: they will also need new software for mainframes and personal computers alike.

Along with various user interfaces and application-development aids, the latest data-base systems do much



1. Helper. The DayFlo system is a personal information assistant that is simple enough for daily use. The command-and-response processor interprets English-language commands; the system processor uses them and the data base for standard functions.

B-trees: the origin of a popular data-access method

The ubiquitous B-trees are not synonymous with binary trees, says Rudolf Bayer, with Edward McCreight the inventor of the B-tree and now a professor at the Institute for Informatics at West Germany's Technical University of Munich. In fact, the two have completely different data structures, though both are used to organize and maintain indexes for dynamically changing random-access files.

In binary trees, used primarily in main memories, a node may have two branches, one branch, or no branches at all. For example, if each node in successive rows on one side of the tree has two branches and if each on the other side has only one, the tree structure becomes highly unbalanced (diagram a). An unbalanced structure considerably slows down the search for information.

B-trees are completely balanced, however. They are organized in nodes, or pages, of fixed size, each holding a certain number of information-identifying index elements, or keys as they are sometimes called. The nodes, which may be only partially filled, contain the information as well as the keys.

If a node is filled up with keys and the associated information, it divides. For example, if two nodes lie in the row below the root node and if one of them is full, it splits to form two "brother" nodes, each only half full (diagram b). The row then has three nodes.

This splitting can continue until several hundred nodes lie in a row. A new row is formed when the root node is split in two and a new root is created. The nodes in the last row are called leaves. There is a weak analogy in nature, says Bayer: for instance, a branch of the dragon willow can split into two, three, or even more branchlets.

As B-trees grow, they remain balanced, since the distance from the root to the leaves stays exactly the same down any path, and this speeds up the search, says Bayer. Moreover, the branching factor is high in B-trees, so they remain quite flat. In practical applications, B-trees have three or at most four levels. For instance, if each node of a B-tree points to 300 nodes at the next level, a two-level tree can index about 90,000 records, and roughly 27 million records can be indexed with a three-level tree.

Balance and the high branching factor make it easy to insert and delete information in data files. Besides speeding up the search, a B-tree index can be maintained with fast and simple algorithms, and B-trees guarantee a storage-utilization factor of at least 66%, Bayer says.

Bayer and McCreight hit upon the B-tree idea in 1969, while they were working on data structures and fast-search algorithms at the Boeing Aircraft Co.'s Scientific Research Laboratory, in Seattle, Wash. At that time, Boeing was developing the 747 and having tremendous data-base problems, Bayer recalls, so the company decided to look for faster search methods. The B-tree concept was first published in a technical report in 1970.

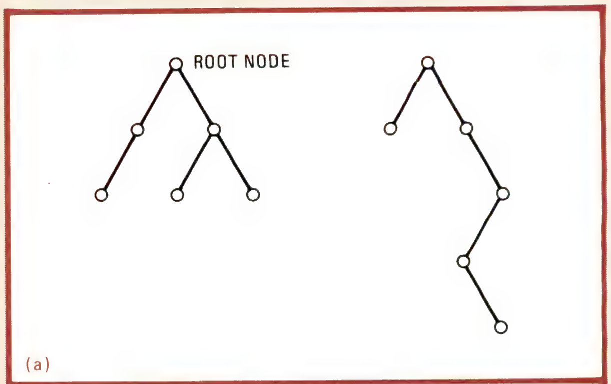
Considering how widely the B-tree and its variations are used in today's data-base systems, it is interesting to note that when Bayer and McCreight sent their B-tree manuscript to the Communications of the ACM for publication, it was turned down on the grounds that the B-tree was not an interesting data structure. The manuscript was published in ACTA Informatica in 1972.

Meanwhile, B-trees have become standard structures in data-base systems. For example, IBM Corp.'s System R, an experimental relational data-base system, and many commercial products are based on it. In general, binary-tree indexes are used chiefly in main memories, B-trees chiefly for files stored in secondary memories, such as disk drives.

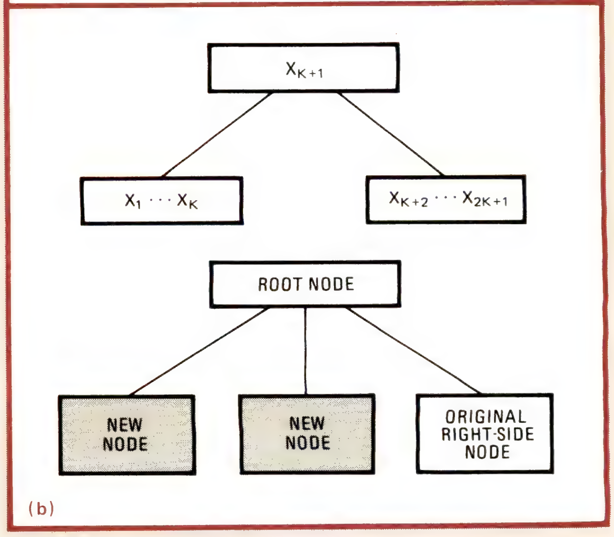
A valuable refinement of the B-tree is the B*-tree, first described in 1973 by Donald Knuth, a Stanford University professor of informatics. It is even more efficient than standard B-trees are, since information is removed from the intermediate nodes—thus increasing the degree of branching—and stored in the leaves only.

Another modification of the B-tree—one that Bayer originated in 1977 with Karl Unterauer, a student—is the prefix B-tree. It speeds up the information search even more than the B*-tree does and helps keep the tree flatter. With prefix B-trees, only the prefixes of keys, not the whole keys, are stored in the intermediate nodes. Prefix B-trees are probably the most efficient variant of the B-tree, says Bayer.

As for other equipment in which B-trees can be used, Bayer cites information-retrieval systems, expert systems, and general indexed-sequential files, such as IBM's virtual-storage access method (VSAM), a much-used commercial variant of the B-tree. **—John Gosch**

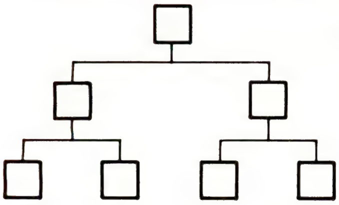
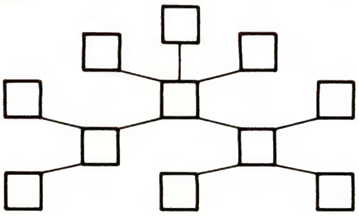
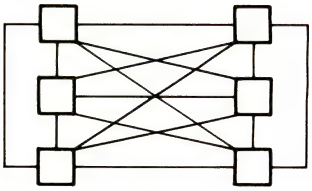


(a)



(b)

TABLE: THE THREE COMMON KINDS OF DATA-BASE SYSTEMS

Type	Structure	Features
Hierarchical 	Data is stored in an inverted tree, also known as a binary tree. Binary-tree nodes may have only two branches and relate only to the parent node and the two child nodes, if any.	Data relationships are fixed at the time the data-base structure is defined. Changes in relationships require changing the structure and reentering all the data. The number of relationships is limited.
Network 	This tree structure resembles the hierarchical one, but nodes may have more than two branches. It can be visualized as a cluster structure.	Many more relationships can be defined in this structure than in a hierarchical one. Changes are just as difficult as they are with the hierarchical model.
Relational 	Data is stored in two-dimensional tables that are also commonly called relations, or files. Completely flexible relationships — all combinations of relationships among all nodes — are possible at all times. Information is accessed by any desired relationship.	This structure is very simple to use and to understand. Tables (relations, or files) are independent of one another and integrated only when a user specifies a join — a logical operation that combines information in the tables. Expanding the data base with new information is easy — just add new tables.

to help end users not only program but actually design their own systems. This trend should and probably will continue. Future data-base systems will in all likelihood have expert aids for system and application design and perhaps even software that handles it.

The hunger for information

"There is a tidal wave of end-user computing demand, which is presenting a great challenge to MIS [management information system] managers," says Bert Winemiller, vice president of marketing at Computer Corporation of America, in Cambridge, Mass. The dramatically improving cost-performance ratios of personal computers have shown the world that personal computing can indeed raise productivity. Professionals are no longer stymied by computers, says Winemiller. "End-user expectations are growing, and users . . . will tolerate nothing but performance from computer systems," he says.

This state of mind represents a challenge for computer and software companies, as well as for MIS departments, which must now provide information tools that perform for managers who are no longer totally ignorant about hardware and software. To provide such tools, computer specialists will have to integrate personal computers and mainframe systems.

International Business Machines Corp., the colossus of Armonk, N. Y., has geared itself up to answer this challenge with a concept that the company calls the "information center." In its Systems and Product Guide, IBM defines the new beast as "an organization within the data-processing department that provides non-DP end users with the tools, packages, techniques, and assistance that will allow them to access data and the resources of their computer directly."

Information centers need software tools and, sometimes, additional hardware. Other companies are offering information-center products, too. The tools used to implement them include query languages and report writers for personal computers, as well as communications links that help users retrieve data from mainframe data bases and use it with such personal-productivity tools as spreadsheets, graphics software, and word-processing packages. Sometimes, the mainframe preprocesses or summarizes the data before sending it to the personal computer, and sometimes the mainframe can provide extended file storage for the smaller machines and serve as a clearing house for electronic mail.

The Computer Corporation of America has revised the information-center concept, calling its unit the "intelligent information center." The company has just introduced an expanded version of that product, which it intends to market as a stand-alone package combining personal-computer productivity software, mainframe decision-support systems, modules from its model 204 relational data-base management system, links from personal computers to mainframes, and links to outside data sources—all of them in a single integrated end-user information system.

Computers do two basic things well: numerical computation and the storage, organization, and retrieval of information. Until now, they have been superb at number crunching and very good at printing out information in long reports. But they have been only fair to good at interacting directly with users to provide just the right information at just the right time.

Selectively storing the right information and getting it back at the right time is the most fundamental thing that office workers do, says Robert Gilchrist, chairman of DayFlo Inc., in Irvine, Calif. It therefore comes as no surprise that his DayFlo software system for business professionals is at bottom a data-base system—one of the newest and most advanced information-management systems for personal computers (Fig. 1).

DayFlo retrieves information by subject. Users can fish for any kind of data automatically, in any order at all, and can temporarily or permanently associate anything with anything else, without destroying old links, old information, or old ways of looking at it. These capabilities

Speaking to computers naturally

Continuing efforts to teach computers the language—or at least one language—of humans have borne some fairly impressive first fruit. But the time has not yet arrived when a human and a machine can have a free-floating conversation with unrestricted subject matter; even the simplest informal conversation between two humans involves many levels of the intellect and a tremendous amount of stored and digested knowledge.

The first efficient and relatively reliable man-machine interfaces using natural languages rely on a severely restricted conversational context, which allows the software developer to build a relatively simple knowledge base—simple, that is, compared with the broad, flexible outlook and knowledge of the goals and beliefs of others that humans normally carry around with them.

A data-base interface deals with an easily restricted domain. In constructing such an interface, the developer can assume that the interaction will always deal with questions about that domain and about it alone. The whole business can be reduced to the problem of translating the natural-language input into a query language that the computer already understands.

Even so reduced, the problem is still complex. A robust commercial system must deal with input that is often ungrammatical and bristles with ambiguities of meaning. For instance, the program must have ways of deciding which meaning of a word is appropriate, to what antecedent such pronouns as "it" or "they" refer, and what has been left out in an ellipsis, a part of a sentence that humans omit because they expect their interlocutors to understand the context. A number of strategies are being used and developed to deal with these and other difficulties of natural language.

In most state-of-the-art natural-language data-base interfaces, a language-parsing algorithm called an augmented transition network [*Electronics*, Dec. 1, 1983, p. 139] parses the input according to its syntax, or grammatical structure. The first major commercial product of this type, Intellect, from Artificial Intelligence Corp. of Waltham, Mass., uses this technique. Intellect, however, can work with queries that are not strictly grammatical. It does this by following the syntactical analysis with a semantic-analysis stage, which produces a query-language representation of the input by taking into account the meanings of the words themselves, not just their grammatical relationships.

Intellect can resolve some ambiguities by just trying out all possible meanings: if one of two possibilities rings a bell in the data base and the other draws a blank, the first is chosen. The program handles pronominal and elliptical references to the previous query. As with other systems, many ambiguities are resolved through dialogue with the users—by asking them to correct misspellings or to define words in terms understandable by the program.

Intellect runs on IBM mainframes and works with such data-base software as SQL and VSAM, from IBM, and Adabas, from Software AG. IBM itself licensed Intellect for distribution to its customers last year. (Cullinet offers a version for use with IDMS/R). Each implementation requires the development of a data dictionary that includes descriptors of the application's data to expand the basic 400-word vocabulary.

Another mainframe program that has just been shipped in production versions this year is Ramis II English, from Mathematica Products Group, Princeton, N. J. The firm claims to have eliminated dictionary start-up costs with a very large general dictionary of more than 4,000 word stems. Two other levels of dictionary are used, including file-specific dictionaries to which new entries can be added at the user's discretion. The program's knowledge base is automatically expanded with use: it keeps a record of queries it does not understand on the first try and the resolution of the dialogue that ensues with the user.

Unlike Intellect, which acts on only one sentence at a time, a single Ramis II English query can consist of more than one sentence. Ramis II English acts on inputs posed in English or in the firm's query language, Ramis II Reporter—or on combinations of the two. A Ramis II data base is not required; Mathematica says that facilities are available to query virtually any mainframe data base. The firm is optimizing Ramis II English to run on the IBM PC XT/370 and expects to have this version ready when IBM starts shipping the computer.

Also just leaving the starting gate is a program called Themis, from Frey Associates Inc., Amherst, N. H. [*Electronics*, Oct. 20, 1983, p. 49]. The first versions will run on VAX minicomputers using Digital Equipment Corp.'s Datatrieve data-base program or the Oracle relational data-base system, from Oracle Corp., Menlo Park, Calif. Themis starts with a 900-word vocabulary and applies script structures, an expert-system technique that helps the program interpret input by trying to fit it into the context of a story-like, or situational, framework, in addition to syntactical analysis.

Natural-language technology is filtering down to microcomputers as well, though in less powerful and versatile forms. Several firms have software that allows a microcomputer to link up with a mainframe and thus use the natural-language facilities running on the larger machine. But for access to small data bases installed on desktop machines, where the natural-language processor is localized, offerings closely approximate those of the human brain, but the results are much more reliable. Says Gilchrist: "1984 is going to be the year of the data base. The big breakthrough in the widespread use of personal computers will come with the use of data bases which are easy for nonprogrammers to use."

Information systems mainly help users communicate effectively with information. Such applications have become too numerous, complex, and difficult to program by conventional means, so a better way must be found to put users in touch with information. The right software can make computers a painless way of dealing with information—insertions and changes, as well as queries and reports. Data-base systems are the foundation and the key to quick and easy access to computerized information. Data-base technology can therefore raise the pro-

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are somewhat more limited in their capabilities.

One product designed for use on the IBM Personal Computer is Clout, from Microrim Inc., Bellevue, Wash. The program, which sells for $195, is tightly coupled with the company's R:base data-base system; instead of producing a query in a high-level language, it accesses the data base at a lower level.

Clout starts off with a 300-word vocabulary, to which the user can add another 500, including words that invoke computation or data manipulation. Intellect, the mainframe product, uses augmented transition networks to parse an entire sentence; Clout uses more localized nets that operate on portions of the sentence. Expert-system heuristics are then used to glue the parsed pieces of the sentence back together again.

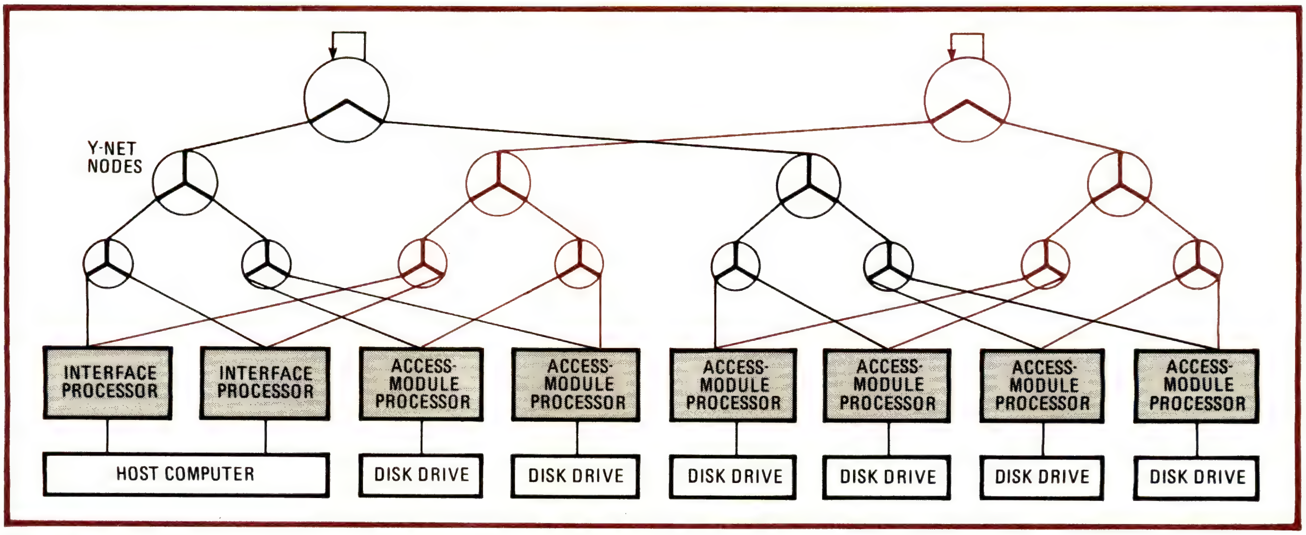
Texas Instruments Inc. has taken a different tack to the problem of natural-language interfaces, offering a product to software developers rather than to end users. The NaturalLink Technology package leads software developers through the process of developing grammars, lexicons, and screens for TI Professional Computer applications. The end result is a menu-based program interface that allows users to select words or phrases and thereby construct sentences that read like English-language data-base queries, among other things.

Many of the problems of ambiguity and vocabulary are thus eliminated by limiting the users' choices at each step in the process. Users think they are putting together a natural-language sentence, but to the system they are merely selecting commands, options, and parameters. The net effect is similar to that of more complex systems, however: users are spared the need to learn a specific set of commands and how to use them; instead, they communicate with the machine in English or another natural language. They are also spared the frustration of not being understood the first time—a fate that can easily bedevil even users of sophisticated mainframe packages.

Natural-language interfaces are rapidly making computer power far more accessible to unsophisticated users and can be counted on to multiply greatly the number of users who are willing to sit down and face the machine. (For those who do not like to type, voice-recognition systems tied to natural-language interfaces will soon ease the burden even further). They also address the endemic shortage of programming personnel in an important way—not by allowing the untrained masses to develop their own application programs but by eliminating the need for many of those programs, allowing users to access their computers without help from programmers. **—Jeremy Young**

```
What different jobs are there in Texas?
PRINT THE UNIQUE JOB TITLE OF ALL EMPLOYEES
WITH STATE = TEXAS.
JOB TITLE
     ADMIN VP
     ATTORNEY
     COOK
     EXECUTIVE VP
     FLIGHT SCHED TECH
     MANAGER II
     OPERATOR
     OPERATOR II
     PERSONNEL CLERK
     PROGRAMMER
     SUPERVISOR I
     VP MANUFACTURING
HIT THE ENTER KEY TO CONTINUE
How many cooks are there?
YOUR REQUEST IS AMBIGUOUS. DO YOU WANT:
     1): LAST NAME = COOK
     2): JOB TITLE = COOK
PLEASE ENTER THE NUMBER OF THE
INTERPRETATION YOU INTENDED.
2
COUNT THE EMPLOYEES WITH JOB TITLE = COOK.
ANSWER: 1
NEXT REQUEST.
Show me salary statistics for all VPs.
PRINT STATISTICS ON THE ANNUAL SALARY OF
ALL EMPLOYEES WITH JOB TITLE CONTAINING VP.
ANNUAL SALARY
     MINIMUM          $33,100
     MAXIMUM          $73,900
     AVERAGE          $48,685
     SUM             $973,700
NEXT REQUEST.
How many of them are upset?
I'M NOT FAMILIAR WITH THE WORD "UPSET." IF
IT'S A WORD YOU EXPECT TO FIND IN THE DATA
BASE, HIT THE ENTER KEY. OTHERWISE EITHER FIX
ITS SPELLING OR ENTER A SYNONYM FOR IT.
Paid less than $40,000.
ANSWER: 9
NEXT REQUEST.
```

Dialogue. Intellect follows a query (in color) about a company's personnel with questions to clarify it or an interpretation of it (both shown in capitals). The answer is in bold capitals.



2. Data engine. The configuration of the parallel-processor Teradata DBC/1012 data-base machine includes a dual Y-net interprocessor connection network, two interface processors for each host-computer connection, and access-module processors and disk drives as needed.

ductivity of all users and not just of programmers.

Most computer applications for individuals incorporate five basic functions: files, searches, sorts, reports, and screen displays—all data-base-related tasks. Since these are fundamental, any serious integrated information system should obviously be grounded upon a firm data structure. "No application can be really good without a data-base foundation," says Larry Ellison, founder and president of Oracle Corp., in Menlo Park, Calif.

At the very least, any data-base system should manage these five basic functions. Whether a complete information system is built around a data base or the data-base system is first built as a stand-alone program, the data-base system should work with or be integrated into other kinds of personal-productivity software: spreadsheets, calculations, graphics, and word processing.

At the core

All data-base systems include three components at the core: the data-management system, a file system, and a user interface. The data-management system is the guts of a data base. The file system, which accesses storage devices, comprises a file and disk handler. As for the interface, it talks to end users.

An efficient data-access method is the key to any good data-base system. Some, such as the Unify system, from Unify Corp. of Portland, Ore., provide a choice of access methods. Perhaps the most common and (for a majority of data requests) efficient data-access method is the B-tree or some modification of it (see "B-trees: the origin of a popular data-access method," p. 132)

The concept of the DBMS is about 18 years old. Data independence is the biggest advantage of these systems. In other words, queries and application programs are isolated from the data and its structure, so that the programs or the data can be changed without affecting anything else. As in most sophisticated software systems, data bases got their start on big mainframes, migrated to minicomputers, and have recently become available on personal computers.

At first, data-base systems conformed to the network and hierarchical models, but today's most popular systems are relational (see table). In the late 1960s and early 1970s, the first commercial integrated data-base systems started showing up. The earliest versions of IBM's Information Management System (IMS), still in heavy use today on IBM and compatible mainframes, arrived in 1969, though its data-base heart—Data Language/I (DL/I)—had arrived around a year earlier. Today, IMS is most commonly used in its virtual-storage version, IMS/VS, introduced in 1974.

IMS was followed in 1970 by System 2000, from MRI Inc. (now part of Intel Corp.), of Austin, Texas. Available first for non-IBM mainframes and later for IBM mainframes, System 2000 grew out of a data-base setup developed at the University of Texas. Both IMS and System 2000 use the hierarchical data model.

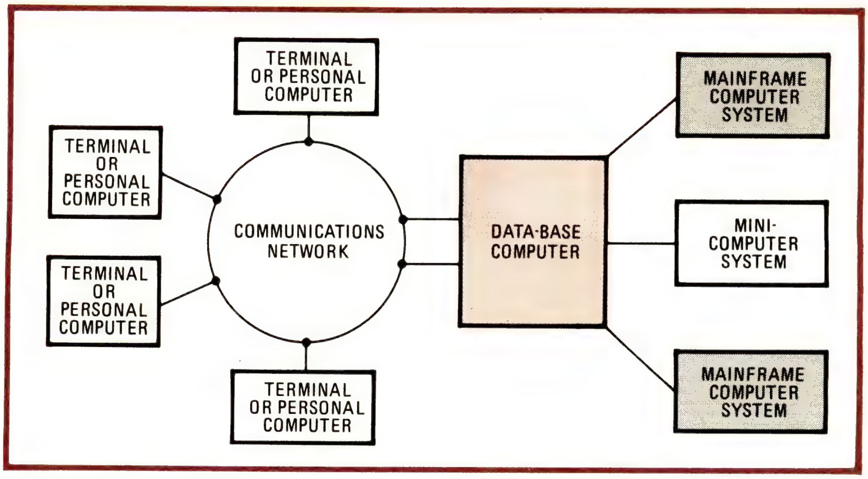
Close on the heels of IMS and System 2000 were competing systems that use the more general network data model. Early ones included the Integrated Database Management System (IDMS), from Cullinet Software; the Data Management System (DMS), from Sperry Corp.; Digital Equipment Corp.'s DBMS-10; Cincom Systems's Total; Adabas, from Software AG Systems Group Inc.; and Ramis, from the Mathematica Products Group.

A relational world

The relational model was first proposed, in 1970, by IBM's E. F. Codd and began showing up in commercial systems late in the decade. It took a while to catch on because the first implementations used central-processing and main-memory resources inefficiently, and these were many times more costly than they are today.

Relational data-base systems have two major properties. First, all the information is represented strictly by data values, without any structural or connecting information that is visible to the user. Second, the user interface is implemented through a very high-level language, in which requests or queries can be formed without algorithmic or procedural specifications. One major advantage of relational query languages is the ease of forming complex queries without *writing* complex programs, a

3. Main line. The new mainline-computing architecture could be a variety of mainframes, minicomputers, and personal computers connected with a data-base computer. For centralized control, this is the distributed-processing architecture of the future.


TERMINAL OR PERSONAL COMPUTER
TERMINAL OR PERSONAL COMPUTER
TERMINAL OR PERSONAL COMPUTER
TERMINAL OR PERSONAL COMPUTER
COMMUNICATIONS NETWORK
DATA-BASE COMPUTER
MAINFRAME COMPUTER SYSTEM
MINI-COMPUTER SYSTEM
MAINFRAME COMPUTER SYSTEM

feature that makes individual users very productive in developing new applications and running ad hoc interactive queries.

The relational view of data—two-dimensional tables of data with fluid relationships among various columns—closely resembles the way people naturally view it. The relational model permits simple one- or two-line statements of a desired answer; the system turns these into an algorithm to get it. Users set forth intentions rather than the algorithm needed to achieve them. Other important advantages of the relational model are data independence and the ability to support very dynamic data-base conditions, where user needs are varied and rapidly changing.

Because modern implementations are much more efficient than the earliest ones, relational systems are now being adopted widely, especially on such small systems as multiuser minicomputers and personal computers, as well as on single-user personal computers and engineering work stations. Besides, the computing resources—main memory and central-processing-unit cycles—are much more plentiful and less costly than they once were.

An unbeliever

Not everyone believes that relational data-base systems have truly arrived in the mainstream, however. Paul Miller, vice president of sales and marketing at Horizon Software Systems Inc., in San Francisco, claims that they are still embryonic data-base systems and still somewhat immature. Miller believes that despite the emergence of a spate of new companies offering relational systems, and despite talk of relational extensions or models at old-line data-base companies, "a full turnover of technologies is still to come." He continues: "We are very far from knowing what we need, and the relational model is just another step along the path of trial and error."

It takes major shifts in software technology 10 or more years to mature sufficiently to enter the mainstream, observes Miller, and then the new technology may have a 10- to 20-year lifespan. For instance, AT&T Bell Laboratories' Unix operating system was first developed around 1970 and has just now entered the mainstream. Relational data-base systems did not really start showing up until the late 1970s.

Miller does not dismiss relational systems, however. From Relational Database Systems Inc. (RDS), of Palo Alto, Calif., Horizon has bought the Informix relational data-base technology for Unix-based computers—a technology the San Francisco company plans to incorporate into its next generation of integrated office-automation systems. (The new products will be introduced in the third quarter of this year.) In fact, Miller regards the relational DBMS as the next wave—essential as a strong foundation for integrated-application packages.

The vendors of relational data-base systems all claim that relational data-base systems have arrived. Such companies as RDS; Unify; Oracle Corp., Menlo Park, Calif.; Microrim Inc., Bellevue, Wash.; Relational Technology, Berkeley, Calif.; Britton-Lee Inc., Los Gatos, Calif.; and Teradata Inc., Los Angeles, may well be right—their products are selling quite well, after all. It hardly matters whether the year of the relational data base turns out to be 1984, 1985, or 1986, because the software industry agrees almost unanimously that the relational model is critically important for putting computer technology at everyone's fingertips.

One of the most important issues in data management is the ease with which users can put data in and get information out. Until quite recently, people who wanted information from computers had to write complicated application programs. Early versions of DBMSs permitted nonprogrammers with a little training to query data bases and to generate reports. However, today's crying need is to give virtually untrained users the ability to access these data bases.

Six kinds of interfaces

Six general kinds of interfaces to data-base systems serve a variety of users with diverse needs. Command-driven interfaces make use of structured commands that are typed into the keyboard—a suitable and effective technique when the same person repeatedly uses a few commands that do not change often. Commands can be quite cryptic and unnatural, for there are few of them and they can be committed to memory.

Many people think that another kind of user interface—structured data-base query languages—resemble commands. Indeed, they are commands, but the query language is designed to be more like a natural one (English, German, French, and so on) than typical computerese would be. Structured data-base query languages are fine for frequent end users who take the time to learn them and for many people who want to build applications that use data bases. Once the user knows the language, it is easy to formulate queries and then store them for use as applications.

This technique is a lot more flexible than command-driven interfaces are. Users can remember the language, at least so long as they use it regularly—rather as they learn and use natural and programming languages.

The third type of user interface somewhat resembles a query language. It is built into standard high-level programming languages, so that programmers can write data-base access statements and data-base system functions directly into programs written in these languages. Such interfaces are for programmers only.

The masses

In fact, these first three user interfaces are not for the largest group of users: nearly everyone who works in an office today. In the future, this group will include just about everyone who works—or just plain everyone. These people need an interface that does not require a huge learning commitment, continuous use, or a love for computers to be workable and enjoyable.

Menu-driven interfaces are good for the masses. Users merely make choices from a short menu of possible commands. If more complicated functions are needed, a hierarchy of menus can be deployed to keep just a small number of choices on display at any one time. Not just data-base systems but plenty of other easy-to-learn and easy-to-use programs use menus effectively.

Another approach to simpler user interfaces is forms-based. A form is displayed on screen. It may contain blanks that users fill in or may be a filled-in form with a very common query shown as an example. Users can go with that query if it satisfies their current need or change any of the form's variable parts to generate a new query, and this form can usually be stored for re-use. Like menus, forms can be organized hierarchically.

The sixth way of simplifying data-base queries is to develop a conversational language that is as close as possible to a natural one—a natural-language interface, in other words. Several such languages have been developed and are starting to be used (See "Speaking to computers naturally," p. 134).

A translation

These four final interface types—high-level languages, as well as menu-driven, forms-based, and natural-language interfaces—often have one thing in common: most translate the user's instructions into the structured query language of the data-base system that is in use. For performance reasons, however, the interface will sometimes go more directly to the data structure.

If relational data-base software is so useful, why not build the concept into hardware and produce a data-base

DATA BASE

☐ Many companies are participating in the computer industry's data-base derby, and this fact in itself indicates the importance of data-base systems in applying the current floodtide of affordable high-performance hardware. Unfortunately, there is not enough space to list all recent data-base products. What follows is a just sampling from a few companies—examples of state-of-the-art data-base systems. They are grouped into five catagories representing more or less separate markets.

1. Mainframe data-base systems with personal-computer links

Cullinet Software Inc.
Westwood, Mass.

☐ Name: IDMS/R.
☐ Description: A network data-base-management system, to which *relational* capabilities have recently been added.
☐ Computers: International Business Machines Corp. and compatible mainframes.
☐ Features: This package serves as the foundation for the company's integrated software, which includes a decision-support system and application packages. The relational capability achieves performance from predefined joins.

☐ Name: Information Database.
☐ Description: A personal-computer-to-mainframe link with a menu-driven interface.
☐ Computers: IBM and compatible mainframes.
☐ Features: The software provides access to mainframe-based summarized data from corporate and external data bases and acts as a clearing house for electronic mail. It implements an end-user information center, where data can be kept on floppy and hard disks, in the Information Database or in an IDMS/R data base.

☐ Name: Cullinet Personal Computer System.
☐ Description: An integrated set of management-decision-support tools.
☐ Computers: The IBM Personal Computer product line.
☐ Features: This is the PC part of the PC-mainframe link, with integrated spreadsheet, graphics, financial-modeling, and document-processing programs.

Applied Data Research Inc.
Princeton, N. J.

☐ Name: Datacom DB.
☐ Description: A relational DBMS.
☐ Computers: IBM and compatible mainframes.

machine that can serve more than one computer from a centralized utility? Several data-base machines have actually been built, though few have been successful commercially. The Content Addressable File System machine, built by ICL plc, of Putney, London, England, has been shipped in small quantities. Data-base machines from Cullinet Software Inc., Westwood, Mass., and Software AG Systems Group Inc., Reston, Va., have just about disappeared.

Even so, success has not eluded all the players. Britton-Lee's Intelligent Database Machine is the first such product to reach the market in any kind of volume: about 300 systems have been shipped, and in 1984, the company anticipates $20 million in revenue for this, its only product. Since early 1982, Intel Corp., in Santa Clara, Calif., has sold a hardware back-end processor—the iDBP 86/440 data-base processor—for a data-base machine; in October 1982, the company also introduced the iDIS 86/735 data-base information system, which is linked to Intel's system 2000 mainframe DBMS. In May 1983, Intel introduced an original-equipment-manufacturer's version, the iDIS 86/730.

Data-base machines can also help implement information centers—or, to be more exact, data-base centers. For instance, Teradata Inc. has introduced the newest and most advanced data-base machine on the block (Fig. 2): the first highly parallel data-base machine [*Electronics*, Jan. 26, p. 50]. Jack Shemer, the company's president, talks about centralizing data-base processing in a specialized machine that can eventually achieve supercomputer performance with a new architecture for mainline computing (Fig. 3).

According to Shemer, "The explosive growth of personal computers and personal computer users is creating a great demand for computing in the hands of professional workers. But personal computers can't do it alone" because all the required information is not locally available. "Though the reasons for centralizing computing may have diminished, they have not been eliminated. We can distribute processing [with personal computers], but we can't distribute the basic business data."

Britton-Lee looks at the market in a similar way. The IDM 500 has been offered as an OEM tool since 1981; now the company is positioning it as a relational database server as well. Its key features—the ability to offload data-base activity from computers of all sizes and its high performance for multiple users—make the IDM (like the Teradata DBC/1012) an ideal central data server in an open architecture for any group of computers, including personal computers. □

☐ Features: The system helps transfer Virtual Storage Access Method (VSAM) data-base applications to Datacom DB. Its access method is faster than VSAM.

☐ Name: Ideal.
☐ Description: A fourth-generation application-building language.

☐ Name: ADRlink.
☐ Description: A terminal emulator and file-formatting program.
☐ Computers: The IBM PC product line.
☐ Features: With this software, users of the IBM PC can access Datacom DB data and also format downloaded data for all popular file types on the PC. In the third quarter of 1984, the company plans to offer programs for electronic mail and program transfers.

Computer Corporation of America
Cambridge, Mass.

☐ Name: Model 204.
☐ Description: An on-line relational DBMS.
☐ Computers: IBM and compatible mainframes.

☐ Name: PC/204.
☐ Description: A micro-to-mainframe link.
☐ Computers: The IBM PC product line.
☐ Features: The PC/204's four parts provide easy, completely transparent access to the mainframe data base, automatic conversion of data to a spreadsheet format, and a popular spreadsheet program. The Communicator uses a communications protocol for error detection and retransmission to ensure error-free data transmission. The Retriever searches for and retrieves information from Model 204 data bases on the mainframe. The Distributor permits applications written in the Model 204 user language to be executed on the PC when the PC is needed for load distribution. The optional fourth part is a version of Lotus 1-2-3 integrated into PC/204.

☐ Name: Access/204.
☐ Description: A decision-support query and report-writing tool.
☐ Computers: IBM and compatible mainframes.
☐ Features: This is a menu-driven syntax-free retrieval and report-writing package. Access/204 and PC/204 can be used to implement what CCA calls the Intelligent Information Center.

Mathematica Products Group
Princeton, N. J.

☐ Name: Ramis II.
☐ Description: A fourth-generation very high-level language and DBMS.
☐ Computers: IBM and compatible mainframes.
☐ Features: More than 20 integrated components provide four major functions: data access, maintenance, and utilization, as well as a user environment. A relate module provides relational views of data extracted from multiple Ramis II files. The data-access functions give read-only access to just about any other data-base and file system.

☐ Name: Ramis II English.
☐ Description: A natural-language interface to Ramis II.

☐ Name: The IT series.
☐ Description: A package of personal-productivity programs, plus a mainframe link.

☐ Computers: The IBM PC product line.
☐ Features: The package includes a data base (KeepIT), a word processor (WriteIT), graphics (ShowIT), a spreadsheet (CalcIT), terminal emulation, and a data-interchange facility with Ramis II (RAMlink).

International Business Machines Inc.
Armonk, N. Y.

☐ Name: IMS/VS-DB.
☐ Description: A full-function hierarchical DBMS that has been the cornerstone of IBM data-base-system applications for many years.

☐ Name: SQL/DS (pronounced "sequel/DS").
☐ Description: A relational DBMS, introduced in 1981 to complement and extend the capabilities of IBM's other data-system offerings.
☐ *Features:* Designed to support interactive queries, report writing, and end-user computing, the system also provides a data-extraction facility to take data from DL/I-based systems and copy it into SQL/DS tables.

☐ Name: VSAM, VSE/VSAM.
☐ Description: The B-tree data-access methods that are used by most IBM mainframe operating systems and data-base systems.

☐ Name: QBE.
☐ Description: An easy-to-use, query-by-example, interactive management-information and data-access system for neophyte end users.
☐ *Features:* Introduced in 1978, this forms-based system allows users to work with a familiar form—a simple two-dimensional table of rows and columns—to request data and to print tabular reports. Users can store queries for re-use and extract data from IMS/VS data bases.

☐ Name: QMF.
☐ Description: Using the Query Management Facility interface, nonprogrammers can access IBM's SQL and DB2 relational data-base systems. For computer professionals, it acts as a high-productivity programming tool for application development and rapid prototyping.
☐ Features: QMF operates with data in SQL and DB2 data bases. It helps users make ad hoc queries in the SQL or QBE languages, prepare reports, define and execute procedures for a series of queries and reports, and prepare data for graphics.

☐ Name: DB2.
☐ Description: A relational data-base system announced in the spring of 1983 and scheduled for delivery in September 1984.

Intel Corp.
Austin, Texas

☐ Name: System 2000.
☐ Description: A hierarchical DBMS with relational data-base access functions.
☐ Computers: IBM and compatible mainframes, the Sperry 1100 series, Control Data Corp.'s 6000 and Cyber series.

☐ Name: iDIS 86/735 and 86/730.
☐ Description: Data-base information systems that comprise a microcomputer, distribution software, and a link to System 2000.
☐ Features: The system combines hardware and software to act as a traffic manager—*interpreting*, storing, and distributing mainframe data to and from terminals and personal computers.

☐ Name: Data Pipeline.
☐ Description: A micro-to-mainframe link.
☐ Computers: The same as the System 2000.
☐ Features: The link provides hardware and software extensions to System 2000. Combined with an iDIS microcomputer, it gives personal computers a mainframe link, an on-line relational data-base capability based on System 2000, and graphics, as well as a fourth-generation application developer.

2. Data-base machines

Britton-Lee Inc.
Los Gatos, Calif.

☐ Name: IDM 500.
☐ Description: A relational data-base computer (Intelligent Database Machine) that functions as a data-base server to computers of any type.
☐ Features: The IDM can be connected to as many as 64 computers simultaneously, *handle* up to 50 data bases, and be expanded modularly with from 1 to 16 storage-module-drive-compatible disk drives, for a total of 10 billion bytes.

☐ Name: IDM System-PC.
☐ Description: An IDM 500 system set up as a data-base server for the IBM PC product line and compatibles. The IDM System-PC can be incorporated in corporate information centers.

Tandem Computers Inc.
Cupertino, Calif.

☐ Name: Encompass.
☐ Description: An embedded relational data-base system for the Tandem NonStop series of transaction-processing computers.
☐ Remarks: Because the Encompass data-base system is actually part of the operating system, Tandem's NonStop line of transaction-processing computers can be looked on as data-base *machines* as well.

Teradata Inc.
Los Angeles, Calif.

☐ Name: DBC/1012.
☐ Description: A parallel processing, highly expandable state-of-the-art data-base supercomputer (see p. 139 for further details).

Signal Technology Inc.
Goleta, Calif.

☐ Name: Omnibase.
☐ Description: A software package to interface Digital Equipment Corp. VAX superminicomputers running the VMS virtual-memory operating system to the Britton-Lee IDM 500 data-base machine.
☐ Computers: DEC VAX models that run under the VMS operating system.
☐ Features: The system consists of several programs to help VAX/VMS end users combine the IDM 500 with VAX software.

3. Data-base systems originally written for minicomputers

Relational Technology Inc.
Berkeley, Calif.

☐ Name: Ingres.
☐ Description: An integrated relational data-base-management and application-development system.
☐ Computers: DEC VAX machines running under the VMS or the Unix operating systems.
☐ Features: Ingres provides visual programming through a forms-based user interface, a performance optimizer, distributed-access data bases through Ingres/Net, an integrated data dictionary, a query language with an embedded version for incorporation in high-level-language programs, Applications-by-Forms, and Query-by-Forms.

☐ Name: MicroIngres.
☐ Description: The same as Ingres.
☐ Computers: MC68000-based computers that run under the Unix operating system.

Unify Corp.
Portland, Ore.

☐ Name: Unify.
☐ Description: A Unix-based relational DBMS with menu-driven application-development tools.
☐ Computers: Virtually any computer that runs under the Unix operating system.
☐ Features: Unify is a complete development system, including a screen handler, a report writer, a menu system, and an SQL-compatible query language. It gets high performance from several data-access methods and its built-in relational join functions.

Oracle Corp.
Menlo Park, Calif.

☐ Name: Oracle.
☐ Description: A *full-function* relational DBMS designed for portability to almost any computer.
☐ Features: The same data-base system, with the same applications, can conceivably run on all the computers a company has. Oracle is IMS-, SQL- and DB2-compatible.

Relational Database Systems Inc.
Palo Alto, Calif.

☐ Name: Informix.
☐ Description: A full relational DBMS.
☐ Computers: Unix-based minicomputers and microcomputers, the IBM PC product line and compatibles.
☐ Features: Informix has a strong nonprocedural report writer, a screen builder, a menu-driven query language, and query-by-forms.

☐ Name: Personal Informix.
☐ Description: An interactive DBMS for novice users.
☐ Computers: The same as Informix.
☐ Features: Personal Informix has a simple, menu-based user interface like that of Lotus 1-2-3 and can be learned in 10 minutes. The instruction manual is embedded in the software. Personal Informix has most of the data-base and screen-building functions of the bigger program but a simpler user interface.

Microrim Inc.
Bellevue, Wash.

☐ Name: R:base 4000.
☐ Description: A microcomputer relational information-management system that evolved from a mainframe relational DBMS.
☐ Computers: The IBM PC product line and compatibles, CP/M systems, and Convergent Technologies and Burroughs computers running under the CT operating system (CTOS) and Burroughs' version of it (BTOS).
☐ Features: The system provides on-line prompts and a help command, a data dictionary, a customized forms-and-menus package, command files for storing query and report command strings, an extended report writer, a macro language for programming, and gateways for data-sharing with popular spreadsheet programs and integrated-application packages.

☐ Name: R:base 2000.
☐ Description: A relational-access data-storage and -handling system for personal computers.
☐ Computers: The IBM PC product line and compatibles.
☐ Features: The system has most of R:base 4000's features but a smaller capacity, as well as prompted commands for easy learning and use and also a step-by-step, computerized tutorial for new users.

☐ Name: R:base 6000.
☐ Description: A multiuser version of R:base 4000.
☐ Computers: Those using Nestar Plan 4000 networks with MS-DOS, systems running CTOS and BTOS, and Eagle Computer's Net systems.

☐ Name: Clout.
☐ Description: A natural-language interface for R:base-series relational DBMSs.
☐ Features: See "Speaking to computers naturally," p. 134.

4. DBMS-based integrated-application packages

Softrend Inc.
Salem, N. H.

☐ Name: Aura.
☐ Description: An integrated-application package with a spreadsheet, word processing, and graphics, centered on a data-base system that implements the information-center concept on a personal basis.
☐ Computers: The IBM PC product line and compatibles.
☐ Features: Aura generates applications with a menu-driven interface; the system output is the formatted result, not a program. It integrates the generation of data-base applications with a spreadsheet, word processing, and graphics and also provides a series of formats for repetitive tasks and optional user-specific menus.

DayFlo Inc.
Irvine, Calif.

☐ Name: DayFlo.
☐ Description: An associative-retrieval fluid-format DBMS with totally integrated word processing and a natural-language interface.
☐ Computers: The IBM PC with expansion-unit hard disk, the PC XT, and compatibles.
☐ Features: Dayflo builds and uses data bases with any mixture of structured and unstructured data (see p. 134); accepts data from other packages, including VisiCalc, Lotus 1-2-3, dBASE II, and PFS; and provides desktop representation—the scanning and manipulation of information as though it were contained in documents in file folders on a desk.

Mosaic Software Inc.
Cambridge, Mass.

☐ Name: Integrated 6.
☐ Description: An integrated package of six functions—data base, spreadsheet, graphics, word processing, communications, and terminal emulation—centered on a relational DBMS surrounded by a spreadsheet acting as the window into and out of the data base.
☐ Computers: The IBM PC and compatibles.
☐ Features: The system uses the spreadsheet not only for standard purposes but also to create, update, and retrieve information from the data base; to transfer information to the graphics and word-processing modules; and to tell the data base to transfer information directly to another PC, a terminal, or a mainframe.

A. D. I. America
Sacramento, Calif.

☐ Name: Aladin.
☐ Description: A complete integrated data-management system—including calculations, statistics, reports, and graphics—all based on a relational DBMS.
☐ Computers: The Apple II and III series, the IBM PC product line, the DEC Rainbow, the DEC Professional 350, the Victor 9000, the Corvus Concept, the Altos 586, the Sage II/IV, and the TI Professional Computer.
☐ Features: Using a modified B-tree access method, Aladin can access data from 2 million records in 1 second. The system also offers query-by-example, a bridge to popular word processors, a script-controlled batch mode, variable-length records, and data compression.

Micro Data Base Systems Inc.
Lafayette, Ind.

☐ Name: MDBS III (Micro Data Base System).
☐ Description: A DBMS that has extended network architecture.
☐ Computers: PDP-11 minicomputers and most microcomputers.
☐ Features: The features of this system resemble those of such mainframe DBMSs as System 2000, Adabas, and IDMS.

☐ Name: Knowledge Manager.
☐ Description: An integrated-application package based on a relational DBMS.
☐ Computers: Microcomputers that are based on the 8086 family or on 68000 processors and that use the CP/M, PC-DOS, MS-DOS, or Unix operating systems.
☐ Features: Knowledge Manager is a relational DBMS, plus spreadsheet, statistical analysis, screen input/output management, forms management, and a structured programming language.

5. Data-base systems developed for microcomputers

Ashton-Tate
Culver City, Calif.

☐ Name: dBASE II.
☐ Description: The most widely used file-management and application-generation tool for personal computers.
☐ Computers: Any computer running under the CP/M, CP/M-86, PC-DOS, or MS-DOS operating systems.
☐ Features: The system offers a relational user interface plus an advanced English-style programming language.

Software Connections
Santa Clara, Calif.

☐ Name: LAN (Local Area Network) Data Core.
☐ Description: A centralized relational data base for a network of personal computers with distributed control. Individual computers run the data-base system, although the data base is centralized on a shared-disk subsystem.
☐ Computers: The IBM PC product line.

☐ Name: LAN Data Store.
☐ Description: A menu-driven version of LAN Data Core for end users.
☐ Computers: The IBM PC line and compatibles. ☐

Bipolar gate array delivers fast signal processing

Board space and power consumption shrink as a fast Fourier transform lands on a chip

by Roger Cox, *Honeywell Digital Product Center, Colorado Springs, Colo.*

☐ Denser and faster bipolar integrated circuits have promoted the construction of truly useful building blocks for digital-signal processing. Whole signal-processing subsystems can now be built on a single chip, and several linked subsystems can provide parallel processing at high data rates. Gate-array circuits, especially, give those who design such systems a flexible way of exploiting high-speed bipolar technology.

The common fast Fourier transform—useful as a performance benchmark for evaluating various architectures and devices (see "FFT: quickstep of the discrete Fourier transform," below)—can be implemented on a single HT5000 bipolar gate array. So for the first time, the data paths, multipliers, and control circuits of a high-speed FFT can be integrated on a gate array. When the FFT arithmetic array is combined with an FFT address-sequencer circuit, the resulting two-chip processor attains performance levels superior to those of conventional designs that use medium- or even large-scale-integration bit-slice techniques.

The architecture of the FFT chip described here is only one example of the many gate-array applications for signal processing. Digital filters, image processors, and graphics-display systems can all be implemented with gate arrays, and all can therefore achieve fast processing rates, low power dissipation, and physical compactness. Large gate-array ICs give designers many advantages of custom designs, though tailoring a gate array for a particular application requires the development only of custom metal masks (see "The HT5000 gate array," p. 144).

While the gate array's input/output circuitry is compatible with low-power Schottky TTL, the array's internal gates use current-mode logic to achieve typical gate delays of only 600 picoseconds. The basic current-mode-logic (CML) function resulting from CML's differential amplifier configuration creates the fundamental OR and NOR gates, with additional inputs provided when more transistors are placed in parallel on the input side.

Each gate's switching point is set by a reference of 3.04 volts. A 500-megavolt logic swing, from 3.30 to 2.80 V, is available both for true and complementary outputs. The transistors are not allowed to saturate, so this small voltage swing is the key to the gate array's fast switching; in fact, speeds comparable to those of emitter-coupled logic are achieved. Yet the absence of the emitter-follower output required with ECL means that CML gates

FFT: quickstep of the discrete Fourier transform

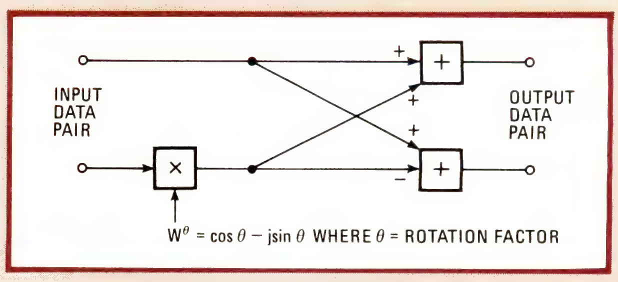
The fast-Fourier-transform algorithm is a quicker way of calculating the discrete Fourier transform, which translates N evenly spaced time samples, f(n), into the waveform's discrete frequency spectrum, F(k). It is defined as follows:

$$F(k) = \sum_{n=0}^{n=N-1} f(n)\, W^{nk} \text{ where } W = e^{-j(2\pi/N)}$$

A brute-force computation of this equation would require N^2 complex multiplications to calculate all N of the F(k) samples. For instance, more than 1 million complex multiplications are suggested by the discrete-Fourier-transform equation for N=1,024, but the FFT requires only 5,120 of them: it achieves the same result by breaking the original sequence, f(n), into many smaller ones, evaluating each and combining *them* to yield the output sequence, F(k).

The FFT saves the greatest amount of computation time when the number of input-time and output-frequency samples, N, is an exact power of 2. In this case, a radix-2 FFT algorithm can be used, breaking the original sequence into N/2 two-point sequences and using the butterfly flow diagram shown in the figure to operate on these data pairs.

The butterfly calculations are performed on the input sequence f(n) and on the intermediate results until the final sequence F(k) is obtained. A total of $(N/2)\log_2(N)$ butterfly operations must be performed, each containing one complex multiplication using the rotation factor, θ. The variable θ depends on n, k, and the algorithm's processing step.


INPUT DATA PAIR
OUTPUT DATA PAIR
+
+
+
−
×
$W^{\theta} = \cos\theta - j\sin\theta$ WHERE θ = ROTATION FACTOR

The HT5000 gate array

The HT5000 gate array is compatible with low-power Schottky TTL but provides the 600-picosecond gate delays required for high-performance signal and array processing as well as for communications. The typical delay through an input and output buffer pair is 8.0 nanoseconds. Active pull-up, open-collector, three-state, and transceiver output-buffer options are available. Other key features of the array include:

☐ Power dissipation of 1 milliwatt per gate, much lower than that of any other LS TTL array. Chip power dissipation is typically 2.5 W.

☐ The ability to integrate the equivalent of 470 74LS74 flip-flops, twice as many as any other LS TTL array.

☐ As many as 76 of the 120 usable input/output pins available as transceivers.

☐ Leadless-chip-carrier packaging or 144-pin grid-array packaging with pins on 100-mil centers.

The chip is organized with 2,048 internal cells, 76 transceiver output buffers, 44 input buffers, 4 logic reference regulators, and 4 gate-current regulators. A single row of bonding pads provides 120 signal and 24 power pins. Die size is 290 by 298 mils.

To build an FFT processor with the HT5000 gate array, the layers of metal interconnections between the uncommitted cells on the standard underlayers must be customized. An application like a 16-bit FFT needs about 1,650 of the 2,048 internal current-mode-logic cells. More than 70 logic-function macrocells are available to designers who want to build systems without the fuss and bother of having to acquire a detailed knowledge of each macrocell's circuitry.

Honeywell will provide computer-aided-design tools to help customers design the array. The tools are resident on Apollo work stations, either at the customer's facility or at Honeywell's. The first step in the design process is to enter the logic design into the system using Mentor Idea-1000 schematic-entry software and the predefined library of logic cells, which range in complexity from simple gates to a complete 16-function arithmetic and logic unit. To check the logic design's functionality and performance, designers use the software's timing simulator and timing verifier. Functional test vectors are developed and can later be used to test the final parts.

At the user's request, Honeywell can perform automatic layout with the design file and test vectors, or it can be performed at the user's facility with the Cadisys automatic-placement, -routing, and -graphics-editing software, hosted on the Apollo system.

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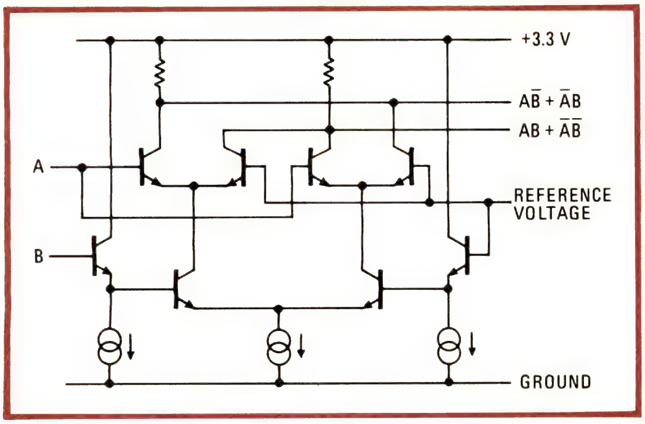
consume much less power, since each internal CML OR/NOR gate dissipates only 1 milliwatt. Moreover, the availability of true and complementary gate outputs helps reduce delays in cascading gates and can also save chip space in many logic designs.

To use more logic functions from the HT5000's cells, the amplifier's current source can be placed in series with an additional level of logic. The resulting exclusive OR/NOR gate (Fig. 1) requires only two of the array's internal cells, yet under a full four-load fanout, it has a worst-case delay of only 1.7 nanoseconds over the entire military temperature range, –55 to 125°C. The XOR gate is the basic building block for the addition, subtraction, and multiplication that the FFT algorithm requires.



1. Current-mode logic. Each exclusive-OR gate uses only two of the array's 2,048 current-mode-logic cells. Both true and complementary outputs are provided. To help with signal processing, the worst-case switching speed is 1.7 ns.

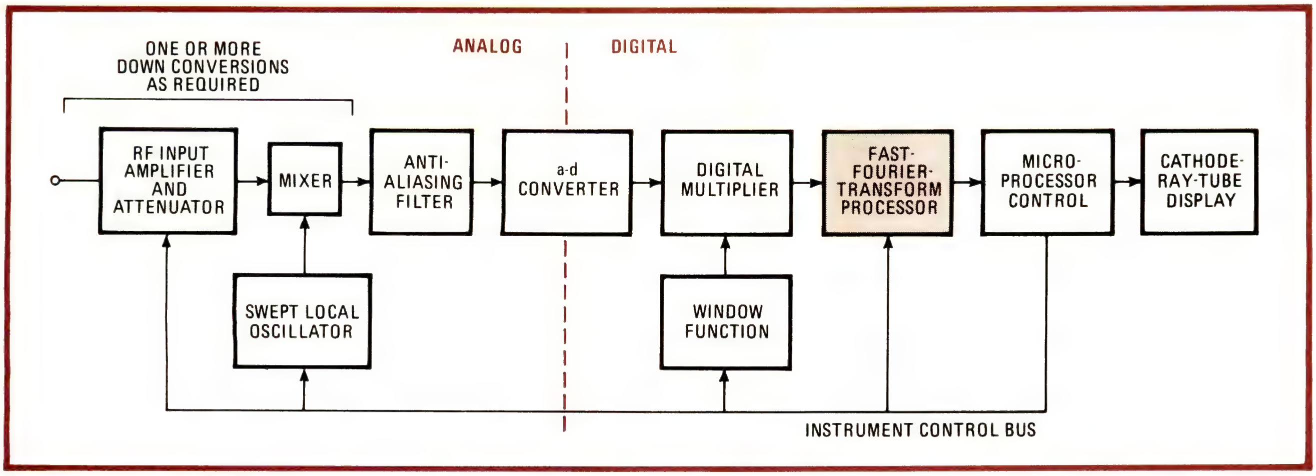
FFTs are most common in spectrum analyzers but have found additional applications in convolution, digital filtering, and image processing. All FFT signal-processing applications have one thing in common: the need for high-capacity number crunching. This the gate-array FFT processor achieves with the compact CML XOR gates. Spectrum analysis, radar-signal processing, and digital filtering are three applications that might benefit from compact FFT processors.

Clean sweep

In modern spectrum analyzers with FFT processors (Fig. 2), many conventional analog circuits—intermediate frequency, detection, and display—have already been replaced by their digital-signal-processing counterparts. Freedom from analog drift or calibration and the ease of building a programmable instrument with convenient digitally stored spectrum displays are two advantages of the digital approach. By making it possible to process an entire part of a spectrum in parallel simultaneously, the FFT makes a unique contribution to spectrum analysis.

The local oscillators of conventional spectrum analyzers must be swept slowly, so signals at each input frequency have enough time to pass through the intermediate-frequency filter and be detected before the next analysis frequency is chosen. So when narrow analysis bandwidths are desired, the sweep rates must be cut and overall measurement times must rise. Spectrum analyzers with FFT i-f structures can usually make comparable narrow-band measurements about two orders of magnitude faster than comparable analog instruments.

Typical spectrum analyzers might make use of complex 1,024-point FFTs, which allow sweep rates that are



2. Faster measurements. *In a fully digital spectrum analyzer, no analog processing occurs after the analog-to-digital conversion.* Real-time operation is the primary benefit, but further processing of the output samples is also possible.

about 200 times higher than those possible with the analog approach. The FFT promotes an additional feature, too—real-time operation, the ability to monitor a part of the spectrum continuously, with no gaps in analysis intervals—because the processor can do the whole transform in less time than it would take to gather the next set of input samples.

Homing in

The FFT has many applications in radar-signal processing, too. Returning radar signals can be digitized in their raw video form and processed entirely by digital circuits thereafter. One example: chirp (swept-frequency) radar. The return pulse has a relatively long duration; if only the envelope of the pulse were detected, very poor range resolution would be the result. Shorter and hence lower-energy pulses improve resolution, but they also have the effect of increasing noise.

To achieve both high resolution and an adequate signal-to-noise ratio, the incoming returns are correlated with a replica of the outgoing chirp signal. Except for a simple reversal of the time sequence, correlation and convolution are basically identical, so the FFT can be used for high-speed correlation. Time-domain radar signals are transformed to the frequency domain and multiplied by the reference spectra of the chirp pulse, and the resulting products are then transformed inversely with an inverse FFT chip to get the desired time-domain correlation. The power and size savings of single-chip FFT processing are especially attractive in airborne radar applications.

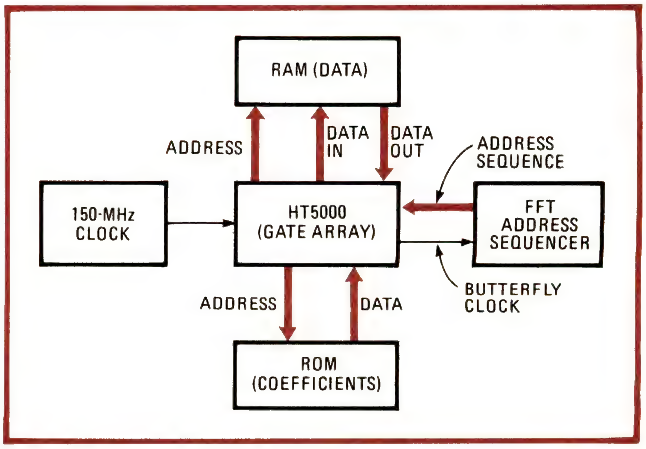
The FFT's ability to perform correlation and convolution extends to finite-impulse-response implementations of digital filters. FIR filters have no feedback elements and therefore produce a purely linear phase shift, which is often desirable. But the number of multiplications often makes it impractical to use FIR filters.

For the conventional sum-of-lagged-products construction, one multiplication per clock cycle is required for each filter section. In a large filter with M (where M is any number) sections, M multiplies are needed for each incoming sample. If the FFT performs the equivalent convolution, however, the number of multiplies goes down substantially. For example, an FFT-processor implementation of an FIR filter with 128 sections needs only 29 multiplies. Two gate-array FFT chips operating in this configuration could support a filter with input sample rates up to 600 kilohertz.

Parallel and serial

When the HT5000 is incorporated in spectrum-analyzer designs, a combined parallel-serial approach makes the most efficient use of gate-array resources, permitting an easy interface to the host system. All data enters and leaves the chip on parallel buses, while every 480 ns the gate array performs a complex multiplication and the associated butterfly operation on each pair of data points. Once the necessary input data has been loaded into an off-chip random-access memory, the FFT can be directed to start the transform operation.

When the computations are complete, the chip signals the host system. The processor interfaces with it through the shared RAM, and the FFT chip directly accesses a read-only memory with sine and cosine coefficients. Separate address and data buses are provided both for ROM (coefficients) and RAM (data). Because of the multiple-



3. Two timer. Extensive pipelining of data in and out of the gate array permits operation with fast bipolar memories. The address sequencer uses the butterfly clock to sequence through the data points while generating the coefficient addresses.

TABLE 1: SYSTEM SPEED USING A 150-MHz CLOCK

Data word length (bits)	Clock cycles	Single butterfly operation (ns)	1,024-point complex FFT (ms)
12	56	375	1.92
14	64	427	2.19
16	72	480	2.46

TABLE 2: FFT IMPLEMENTATION COMPARISONS

Implementation (1,024 samples)	Power (W)	Speed (ms)	Number of ICs*	Printed-circuit board space (in.^{2})
HT5000 serial/parallel	4.5	2.46	2	5
Large-scale TTL bit-slice — parallel	17.2	2.04	21	41
Medium-scale TTL — serial/parallel	12.0	7.38	86	60

*Does not include coefficient or data-memory ICs.

bus architecture, data can be transferred rapidly in and out of the chip. Figure 3 shows the FFT chip's architecture, including the ROM, the RAM, the address sequencer, and the HT5000 signals and data. Extensive pipelining permits the internal arithmetic circuits to run at maximum speed, and the FFT chip's interface timing permits the use of off-the-shelf bipolar RAMs and ROMs with access times of 30 and 120 ns, respectively.

Inside the HT5000, the actual computations are performed with serial arithmetic using a 150-megahertz internal clock rate. Because this high-frequency clock signal is above the practical range for TTL circuits, some other clock input circuit is needed, such as coupling an ECL gate to an input-buffer prescaler cell. The prescaler's output, a sine-wave signal, then drives a second gate, which squares up the clock for internal use. While this scheme employs an ECL level for the clock, all other control and data lines on the FFT processor remain TTL-compatible and operate at much lower speeds.

The serial architecture minimizes on-chip interconnections and produces a fast design that is both space- and power-efficient. Seventy-two clock cycles are required to complete the multiply-butterfly operation on the complex 16-bit data. The data path consists of two 16-by-16-bit multipliers and six arithmetic and logic units.

Word width

Serial arithmetic can also help promote certain trade-offs between word length and processing speed. For example, with the data words reduced to 12 bits, only 56 clock cycles are needed, and the multiply-butterfly operation takes only 375 ns.

Although inadequate for some high-resolution applications, the 12-bit data width is certainly sufficient for high data-rate applications where the system's analog-to-digital-converter word width is the limiting factor. Timing analysis shows that the registers can be clocked at 150 MHz throughout a temperature range of –55 to +125°C. Table 1 shows the effect of 12-, 14-, and 16-bit word lengths on system speed.

The FFT algorithm is highly repetitive, so microprogrammed control is not required. For 1,024 complex input samples (N = 1,024), a total of 5,120 identical butterfly calculations are needed. The butterfly counter in the companion address-sequencer chip counts these iterations. Its output in turn controls the generation of ROM and RAM addresses, so that the proper data pair and coefficients are selected for each iteration.

To choose the FFT size the host system needs, users can program the butterfly-counter sequence. A companion algorithm—the inverse FFT, used for frequency-to-time-domain conversions—employs the same butterfly operations and the same data sequencing, with only a sign change in the coefficient data and a simple overall scaling-factor change. (These details are handled by control logic on the gate array.) The inverse transform is therefore available.

To evaluate the performance of the 16-bit serial-parallel gate-array design, the comparable FFT processing function was designed with a similar serial architecture based on TTL MSI packages as well as a full parallel design that uses the fastest available TTL bit-slice component. Table 2 compares the performance of these FFT processors with the HT5000's.

Using a parallel multiplier, the bit-slice design separates bit-slice data paths for real and imaginary data. ROM-based microcode control consumes the greatest amount of power; in fact, the power needs of the microprogrammed controller alone are twice as great as those of the entire gate-array chip. The 16-bit gate-array design is slightly slower than the bit-slice approach would be but consumes about one fourth as much power. Serial MSI TTL design is slower than the HT5000 gate array because only a 50-MHz clock is practical.

Although the HT5000 FFT uses both serial and parallel circuits to minimize chip count and power, an all-parallel approach (using a combination of parallel multipliers and gate arrays) promotes even faster processing. Except for the multipliers, the HT5000 could be used to build all the parallel data paths.

If two parallel multiplier chips replaced the on-chip serial-parallel units, all butterfly operations would take less than 200 ns. At these high speeds, the data RAMs' access times would become the limiting factor because memories with access times in the 15-to-20-ns range would be needed. For even higher speeds, a more parallel architecture would be required, allowing several different memories to be accessed simultaneously.

To achieve maximum performance, one gate-array chip could be installed for each butterfly in the FFT algorithm and the chips cascaded to feed data to one another. This configuration would require no data RAMs or address-sequencer chips. For a 64-point complex transform, say, 192 HT5000 gate-array chips could be connected to build the entire data path. The resulting array could perform a complete a transform in 480 ns.☐

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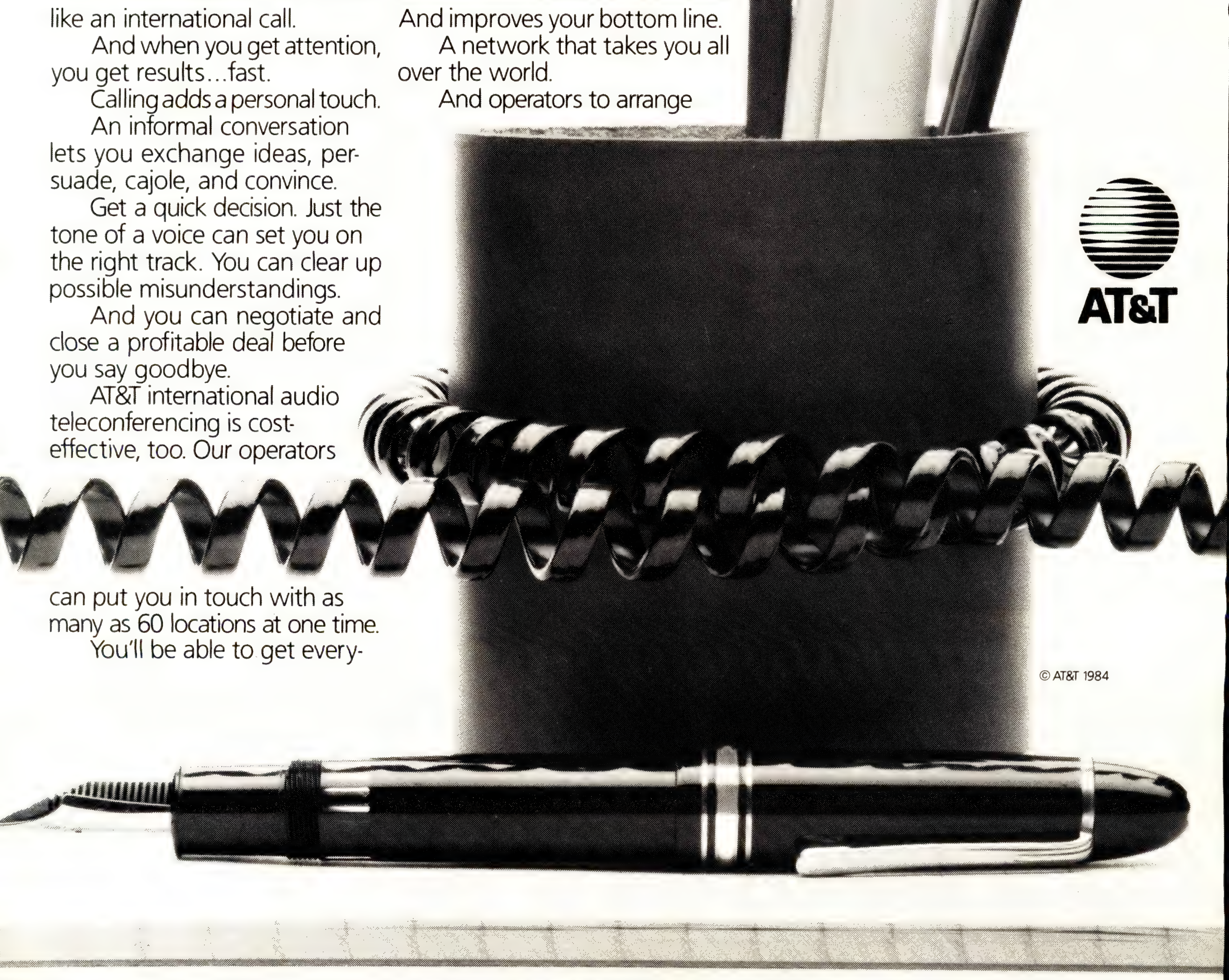

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Dynamic-signal analyzers can tune electronic components on the run

Now engineers can adjust components or tune circuits while observing the changing response in real time

by Michael Apker, *Hewlett-Packard Co., Lake Stevens Instrument Division, Marysville, Wash.*

☐ Signal analyzers coupling fast Fourier transforms with digital signal-processing techniques are challenging traditional swept-generator analyzers in applications at and below 100 kilohertz. With this new tool, a designer can collect and display as many as 60 separate spectra in less than 10 seconds. Thus, for the first time, an engineer can tune a circuit or component with a 1-hertz or narrower frequency spacing and observe the changing response in real time. Applied to a production-line flow, a dynamic-signal analyzer offers the potential for a rather significant boost in productivity.

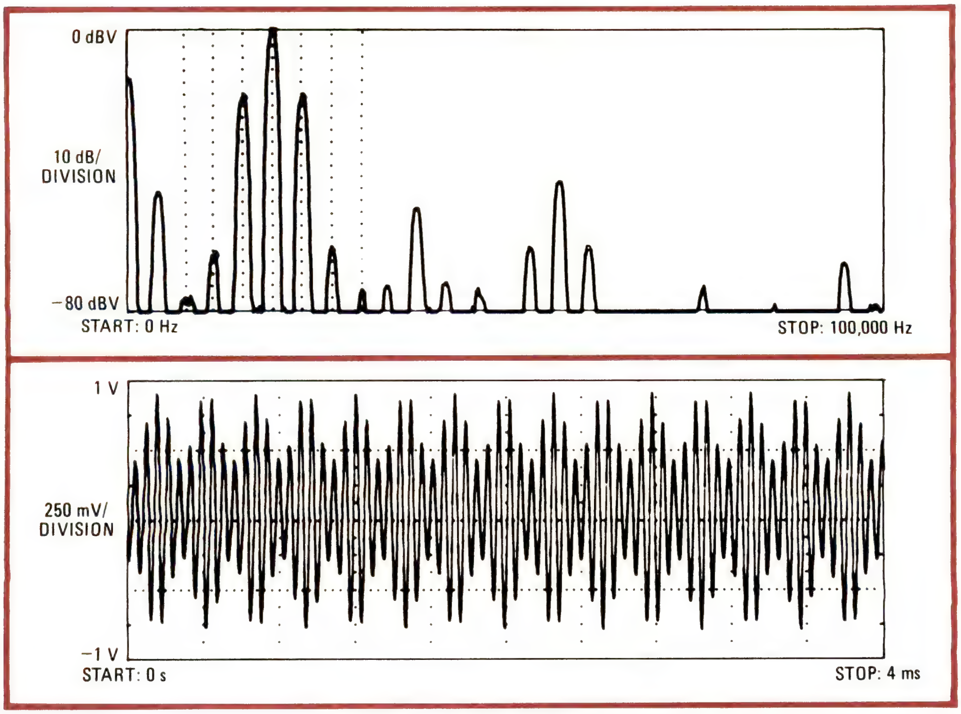
Since the analog test signal that enters such an analyzer is digitized before processing, it is simple to store the displayed waveform in digital memory or to place the digitized data on a bus for transfer to a computer and from the computer to a mass-storage device and vice versa.

The FFT essentially takes a snapshot of the test signal and then applies a mathematical operation to the digitized data. The process is much faster than that performed by a traditional swept-frequency spectrum analyzer, which must sweep a tunable filter through the frequency range, wait for the filter to settle at each measurement point, and then read the energy at that particular frequency. With a specialized pseudorandom noise source, a single-channel dynamic analyzer can also function as a network analyzer. In fact, such an analyzer can serve as three measurement tools in one: a fast spectrum analyzer, a traditional network analyzer, and a low-frequency waveform recorder.

Three-in-one tool

An oscilloscope provides time-domain information while a spectrum analyzer displays the frequency domain, both valid for test and measurement applications. Dynamic-signal analyzers offer both time and frequency data, since they use the FFT to derive the frequency content of a signal (Fig. 1). Thus, an engineer can use one as a counter to measure frequency, as a digital scope to measure time delays, and as an ac voltmeter to measure power. He or she can use basic spectrum measurements to compute power within a frequency band and to measure distortion, noise floor, and spurious responses of a signal source. Modulation, too, is commonly analyzed in the frequency domain, since the frequency spectrum can supply more accurate information about the type and amount of modulation than a time-domain display can.

Dynamic-signal analyzers perform network measurements by providing a tracking pseudorandom noise



1. Simultaneous display. A dynamic-signal analyzer, using fast Fourier transforms to derive the frequency content of a signal, provides a simultaneous-frequency (top) and time-domain (bottom) display of a modulated carrier. Markers pinpoint the modulation sidebands.

source to excite a network with energy in the analysis band (Fig. 2). By measuring the response to the noise source (which is flat in the frequency domain), the network or frequency response is determined. Where high accuracy or phase response is desired, these analyzers typically provide a trace-math facility to divide the input spectrum into the response spectrum, thus producing an accurate network measurement to characterize analog circuits, crystal-switched capacitance filters, baseband amplifiers, and modems.

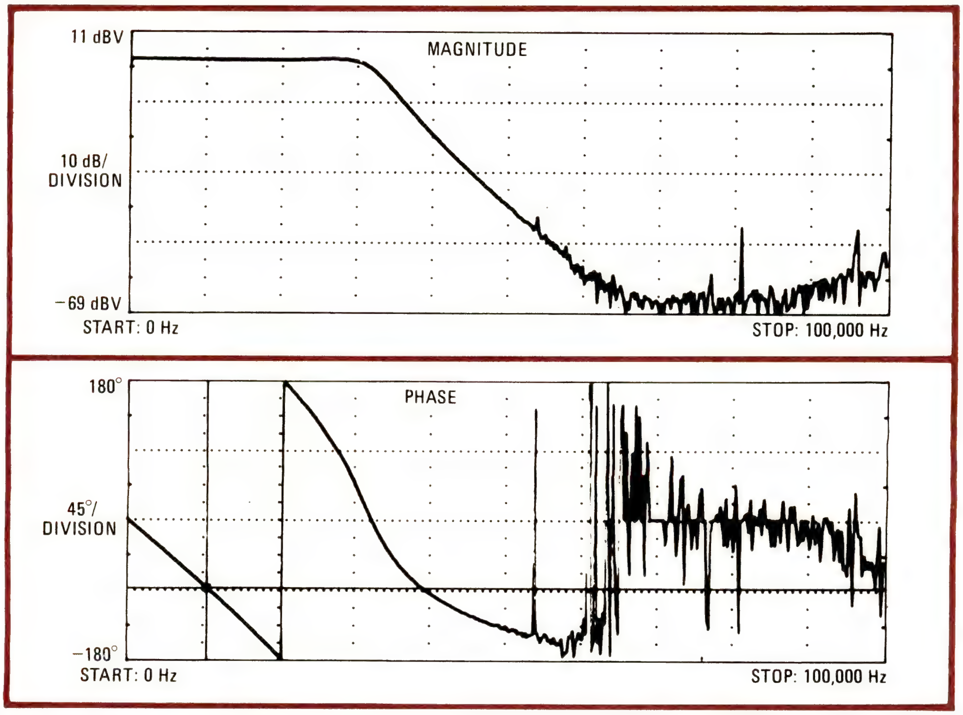
Waveform recorders are used for sampling transient or once-only events in the time domain. Examples include voice-waveform capture, explosion responses, disk-head motion, the turn-on transients of electrical devices, and mechanical shock analysis. Voice-analysis applications need both spectrum and waveform capabilities. With the dynamic-signal analyzer's ability to record up to 60 complete spectra in under 10 s, these spectra can be stacked, producing a three-dimensional spectral map of sequential time slices (Fig. 3).

Range of applications

One place where a dynamic-signal analyzer would come in handy is in tuning the harmonics out of a function generator coming off a production line. Traditionally, the typical sequence of events is to take a swept-spectrum reading, analyze the resulting trace, adjust the most likely trimpot in the function generator, take another spectrum, and continue. This would go on until the generator meets specifications.

The dynamic analyzer that could be employed could have a bandwidth of up to 100 kHz and be capable of simultaneously viewing as many as 20 harmonics of a 5-kHz sine-wave output from the function generator. Since the analyzer's display can be updated with fresh data seven times each second, a technician can tune the function generator and observe the changes produced in real time, thus considerably reducing test time.

Another application is tuning out closely spaced 60-Hz line harmonics, a difficult task with swept analyzers, since it requires very fine resolution. The dynamic-signal analyzer can provide a wide selection of frequency ranges and resolution and can do so much faster than a swept analyzer can. In such a unit, resolution is defined as the bandwidth divided by the number of lines, or digitally synthesized filters, the instrument offers. A 400-line analyzer can therefore provide very narrow resolution limits. By reducing the frequency span, 2-Hz or better resolution is possible, and that is more than enough to identify 60-Hz harmonics.



2. Filter snapshot. The amplitude (top) and phase (bottom) response of a low-pass filter is obtained using the dynamic-signal analyzer's tracking pseudorandom noise source for excitation. If higher accuracy or phase response is desired, the analyzer's trace-math capability can be applied.

Crystal filters

The adjustment of close-tolerance crystal filters is another application suited to the speed and accuracy of dynamic-signal analyzers. High-Q quartz crystals are ideal for filter components, particularly in the communications industry. Crystal filters are typically designed in a lattice connection, with interconnected crystal-capacitor pairs. On a monolithic crystal filter, the capacitors can be laser-trimmed to tune the network to meet performance specifications. Instruments that test such filters must be very accurate, provide repeatable measurements, and resolve minor harmonics 70 decibels or more below the filter's fundamental frequency. A dynamic analyzer with a built-in noise source and resolution to 640 microhertz provides very accurate measurements.

The analog-to-digital conversion technique within these analyzers is very stable, so measurements made over time are repeatable and directly comparable. Such data as how a particular circuit design responds to changes in temperature, humidity, or air pressure is generally required when a new product is qualified to military specifications. The dynamic-signal analyzer can take a spectrum signature once a minute, if the need is for a constant time axis, or every time the temperature changes by 1° (for example), if the need is for an evenly spaced temperature axis.

The 3-d spectral-map mode of some dynamic-signal analyzers gives engineers a quick visual overview of trends that may have developed during the test. It is then possible to call up just a single trace of interest of the 60

Inside the HP-3561A dynamic-signal analyzer

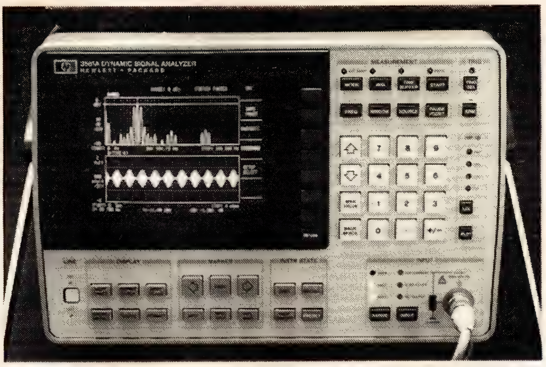
Ease of operation, a wide dynamic range, versatility of measurement modes, and high-resolution zoom analysis are the key features of the HP-3561A (left). Seven soft keys, so called because their functions change according to the menu displayed, are used to select setup parameters and to make rapid control entries. Soft keys on the right side of the display perform one of four functions: select from a number of entries, toggle between on/off, select from a second-level menu, or define a parameter. The 80-decibel dynamic range, with alias protection, simplifies the location and identification of a small signal in the presence of a much larger one.

Four measurement modes are available: 1/3 octave, full octave, and time capture. Narrow band (right), the fourth and commonest mode, provides constant resolution equal to the frequency span divided by 400. The 1/3- and full-octave modes provide resolution proportional to frequency, a property found in the human ear, and thus are convenient for acoustic applications. The time-capture mode configures the 3561A as a waveform recorder and provides a 40,960-sample input memory for recording long transients or hard-to-repeat signals.

For maximum flexibility, two traces can be defined independently, with a selection of six trace definitions and four formats. The six trace *definitions* are amplitude-frequency spectrum; phase-frequency spectrum; time samples taken directly from the analog-to-digital converter; filtered time samples, which are used for the frequency transform; 0-to-100-kilohertz magnitude, useful when full span and zoom span are displayed simultaneously; and magnitude or phase display, modified by a math function.

The four available trace formats are full screen, single trace; two-trace upper/lower split screen; two-trace front/back display; and spectral map. Amplitude can be expressed in volts, milliwatts, or user-defined engineering units. Log or linear scaling can be selected for both amplitude and frequency axes. Moreover, it is also possible to obtain a display with linear amplitude readout but also with log amplitude scaling.

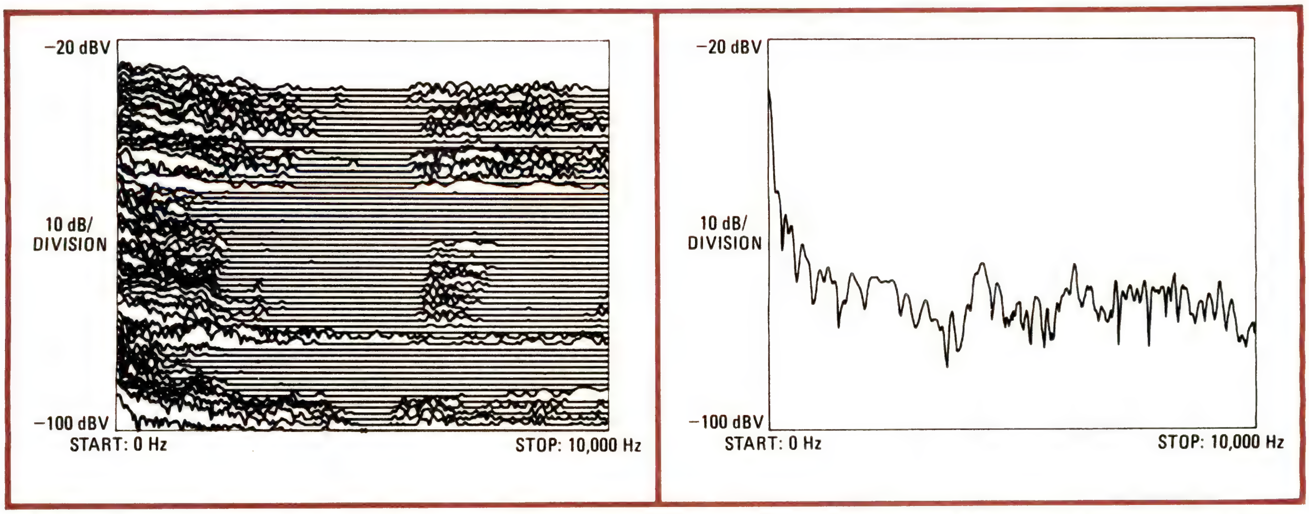
With resolution at full scale equal to the frequency span divided by 400, it is necessary to narrow the span in order to improve resolution. When the object of interest is a group of components closely spaced around a particular frequency, it is easiest to define that frequency as the center of the analysis span. In this way, the frequency span can be changed without affecting the position of the frequency of interest. If it is more appropriate to think of the analysis in terms of start and stop frequencies,



that are displayed and to perform detailed investigations of what happened at that particular combination of environmental conditions.

Product quality monitoring on a production line may involve data collection over weeks or months rather than minutes or hours. On a high-volume production line, it might not be economically feasible to put each unit manufactured through an exhaustive final check. Instead, only a few key parameters might be specified; if a unit met these specifications, it would ensure—to a fairly high level of confidence—that the unit's other parameters were also within limits.

A unit such as the HP-3561A (see "Inside the HP-3661A dynamic-signal analyzer," above) with an option-



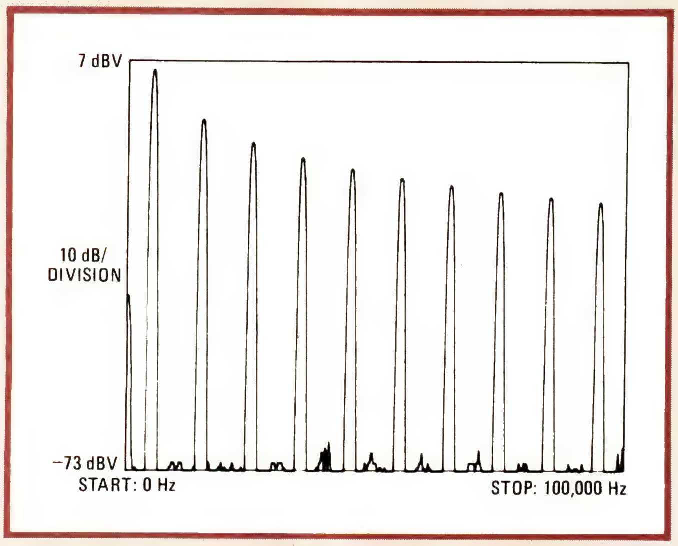
3. 3-d patterns. A spectral map (left) is useful to identify trends in circuit or device test results because it adds a third dimension to the display. The spectral map of the word "spectrum" is produced by stacking multiple slices of the analyzer's waveform recording output (right).

the 3561A can make use of that approach as well.

Two types of zoom are offered: real time and time capture. Real-time zoom in the narrow-band mode provides instantaneous high-resolution analysis, useful with rapidly changing signals or when adjustments are made to a component or circuit. Zoom from the time buffer in the time-capture mode allows repeated zooms on the stored data. This capability is especially useful when one-time or difficult-to-repeat events are to be analyzed.

Two types of time data display are available: real and imaginary time, as well as input time. Real and imaginary time are the filtered and sampled time data used to compute the fast Fourier transform. Input time is the direct output of the a-to-d converter, which operates at 256 KHz regardless of the frequency span. The analyzer displays time in seconds and amplitude in volts, which makes the 3561A useful as a waveform recorder.

Transient signals can be captured in a single-time record (1,024 samples) or in up to 40 records (40,906 samples) in the time-buffer memory. Triggering can be on an input level or an external TTL pulse, or initiated manually. Pre- and post-trigger delay make it possible to capture transients that occur before or after the trigger. The time-buffer memory allows long transients to be captured with a high sample rate. Data collected in the time buffer can be stored in the optional nonvolatile bubble memory.



Digital averaging can be used to improve the accuracy and the signal-to-noise ratio of measurements and to hold the peak value at each frequency point. Four types of digital averaging are available: root-mean-square, rms-exponential, time, and peak-hold.

The 3561A's spectral map shows on a single screen how the frequency spectrum varies with time, a feature not available from a frequency-domain display. Nonlinear network analysis can be improved if several frequency-response functions are plotted versus the nonlinear variable. Using a spectral map, it becomes possible to display network response versus input voltage, power supply voltage, temperature, or any other variable.

Trace math allows the user to perform the following operations on frequency spectra: add, subtract, multiply, divide, integrate, and differentiate.

al nonvolatile bubble memory is well-suited to long-term monitoring, since it can store up to 127 separate signature traces. These traces can be collected minutes, days, or even weeks apart and stored indefinitely. Thus, without any need to resort to an external computer, floppy disk, or tape, the analyzer can collect and maintain its own data base of test signatures. Periodically, quality-assurance personnel could make the rounds of production-line test stations to review the collected trend data. They could use the spectral-map display to spot any deviations or inconsistencies quickly.

Detailed processing

When required, the signatures stored inside the 3561A's bubble memory could be transferred to a computer for more detailed processing. Most dynamic-signal analyzers have this data-transfer capability, and some even have direct-to-plotter features built in as well. With direct-to-plotter output, it becomes a very simple matter to get a hard copy of trend data for quality-assurance files and for reference.

When magnetic phonograph cartridges are produced, every unit must be checked for transient response, trackability, and stylus compliance. Typically, the test stimulus is a special record with sine waves of varying frequencies and amplitudes combined in various patterns.

Traditionally, to characterize transient response, the test record exercises the stylus to reproduce a square wave, with an oscilloscope being used to measure rise time and overshoot. A dynamic-signal analyzer can not only provide a time-domain display, just like a digital scope, but also supply a frequency-domain display yielding phase information at the same time.

Trackability is a measure of how well the stylus can stay in the record groove when subjected to large amplitude variations; compliance is a measure of how well the stylus can track high-frequency signals. Both measurements are influenced by stylus mass and flexibility, and degradation in either shows up as distortion easily identified in the frequency domain. Some digital analyzers have built-in harmonic power computations for quantifying such distortion.

Much of the transient-response, trackability, and compliance performance improvement can be adjusted at the final test station by variations in the needle mounting tension, pickup coil positioning, and stylus counterbalancing. Since the waveform in a dynamic-signal analyzer is stored and processed digitally, user-defined mathematical operations can be applied to the signature data. It thus becomes feasible to store the response signature of a good stylus and then take advantage of the analyzer's trace-math capabilities to subtract the reference signature from the measured one; only the distortion products will then be displayed. ☐

Fail-safe rapid-transit engineering ensures reliability, passenger safety

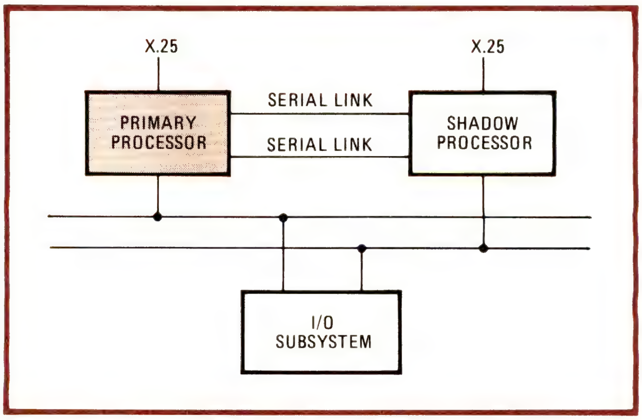
Redesigning the BART subway with redundant hardware and software aims to make both the ride and the service more trouble-free

by Gary A. Kravetz, *Fail-Safe Technology Corp., Los Angeles, Calif.*

☐ A new fail-safe computer system—the Fail-Safe 86—will soon be installed in 45 stations of the Bay Area Rapid Transit (BART) District, in the San Francisco Bay area. The new system architecture—which uses standard, proven industrial components combined with a versatile real-time operating system—is fault-tolerant and combines modularity with reliability. Although the Fail-Safe 86 computer is built around the reliable 16-bit Intel 8086, it is not the hardware that guarantees fault tolerance; that is the job of the software architecture, which raises system availability to levels higher than 99.986% with a minimum amount of extra hardware.

The existing BART transit system is one of the most automated in the U. S., but its centralized minicomputer, with a simple unintelligent digital encoder/decoder at each station, is not very reliable and has little potential for upgrading. A new system-control technology, called the Integrated Control System (ICS), will achieve much higher reliability and can accommodate increased automation of the BART system.

The ICS consists of two functional parts—a central computer, which provides the operator interface and overall system-management functions, and a process input/output system located in each of the 45 stations. The process I/O's responsibility is to monitor and control up to 1,000 points in each BART station. These might typically include tracking such varied functions as air conditioning, lighting, mechanized ticket dispensing, and train-location sensing. The central computer initiates the control signals, and the process I/O system executes them. The latter must also format all the status data from sensors, then (using X.25 protocols) transmit data packets over phone lines to the central computer. The initial process I/O system installation represents an upgrading of existing automation capabilities, but there are plans to expand its functions to provide higher levels of automation, monitoring, and control of the installation.



1. Redundant processors. Primary and backup, or shadow, processors provide the redundancy required to achieve a very low mean time between failures. The processors communicate serially, are cross-strapped to the input/output subsystem, and communicate with the central computer over telephone lines.

The process I/O system consists of a dual redundant Fail-Safe 86 processor that communicates with a cross-strapped I/O subsystem (Fig. 1). The Fail-Safe 86 can address up to 1 megabyte of memory with the 8086 processor and up to 16 megabytes with the 286.

One Fail-Safe 86 processor is designated as the primary one and performs the process I/O functions; the other is designated as a shadow to check the primary processor and take over if it fails. This architecture was chosen to make processors available almost continuously and to facilitate repair.

Redundant network

The central computer and the process I/O system communicate through a redundant star network. The central computer—which has the responsibility of scheduling, of monitoring the systems in each station, and of safety—uses a command sequence of operation for each device process I/O (that is, a logical unit) in the system. For example, to control ventilation in a BART station, the central computer must send a set of commands to the process I/O system to perform an operation—starting or stopping a fan, or reversing its direction. The system must then translate the logical-device commands into the manipulation of multiple physical control lines and must monitor the sensors required to ensure that the commands are carried out.

Partitioning the work between the central computer and the process I/O system offloads responsibility to the local microcomputer, thus allowing the central computer to concentrate on a higher-level command throughput. The net result of this philosophy is high availability, where availability is defined as the total up *time* divided by total time: A=MTBF/(MTBF + MTTR), where A is availability, MTBF is the mean time between failures, and MTTR is the mean time to repair. To meet the goal of providing an overall system availability of 99%, each process I/O must be available 99.986% of the time—and this cannot be done with simple (nonredundant) hardware. To accomplish this, each process I/O must be available if:

- It is listening to at least one communications link.
- It is controlling BART.
- It is monitoring the BART plant.
- No more than 10% of its plant interface has failed.

Although the process I/O system is configured to handle up to 1,000 I/O points, it remains cost-effective with only eight. Any failure in the I/O system will not cause a loss of more than 10% of the I/O signals, though for more critical applications, redundant channels are created to ensure that a single subsystem failure cannot cause a loss of critical control signals. This design also permits hot sparing, thus ensuring that virtually any component in the computer or I/O systems can be tested and replaced while the system is in full operation.

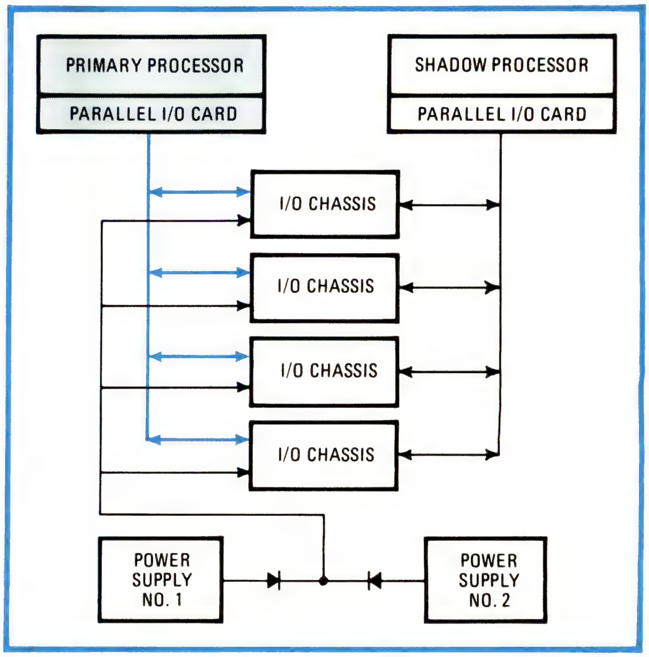
The primary and shadow processors are connected by a dual redundant serial communications path. A dual redundant bus connects the processors to the cross-strapped I/O system, so that both processors receive status information (Fig 2). On power up, the primary processor is assigned control of the I/O subsystem; it communicates control information to the central computer and keeps the shadow processor current through a loosely synchronized timing scheme and the periodic exchange of check data, which consists of device-status tables, system-control parameters, and self-testing information. When a discrepancy between the primary and shadow processors is discovered, the two attempt to resolve it. In all cases, the central computer is notified that an error has been detected, so that it can help resolve the problem.

The central computer can reconfigure the role of primary and shadow processors between redundant processors. With a knowledge of the process I/O system's past behavior and the results of self-testing procedures, the central computer can make accurate decisions about the health of each processor. This design makes the central computer a central arbitrator in those rare cases when a problem cannot be resolved locally.

The architecture for the I/O subsystem consists of an optically isolated, Multibus-compatible, parallel I/O card for both processors, as well as four 16-card I/O units, each with its own buffer electronics (Fig. 3). The optical isolation maintains electrical separation between the primary and shadow processors and between the processors and the I/O units.

Software for safety

An important design criterion was to ensure that a single failure affects no more than one card, so an architecture was established to route control signals from the primary and shadow processors to each I/O card. If any single failure occurs in the communications link between the primary processor and the I/O cards—for example, a failed Multibus I/O card, a broken wire, or a failed receiver on a single I/O card—the shadow processor can control the entire set of I/O cards. Redundancy is also a part of the power-supply design; dual redundant, cross-strapped power supplies are specified, thus ensuring uninterrupted power.



2. Modular input/output. Each I/O chassis can handle up to 1,000 signaling points but still remain cost-effective with as few as eight. A failure in any part of the system will not affect more than 10% of I/O.

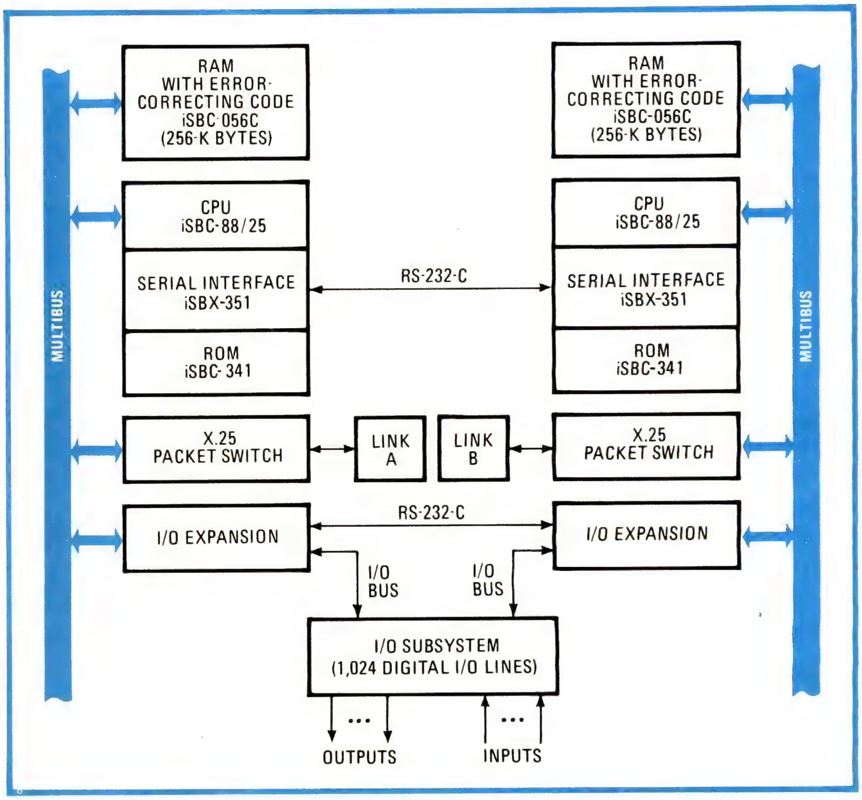
Fault-detection software works on the principle of matrix isolation of faults. By providing two totally independent software systems for detecting them (Fig. 4), the Fail-Safe 86 can detect more than 99% of the on-line faults without significantly reducing the speed of the application software. Since most faults are actually transient in nature—such as bit flips caused by static discharge or power-line noise—the fault-detection software is designed to minimize them. After a potential fault is detected, testing is redone; if the fault no longer exists, the data base is restored.

The software subsystem is responsible for:

- Building and routing application-level messages from the central computer.
- Building the stations' device commands.
- Initiating station-indication sampling.
- Timing device-word delays.
- Checking for faults.
- Controlling I/O subsystems.
- Controlling primary and shadow processors.

The software subsystem is composed of three major modules: an off-the-shelf real-time operating system, application software, and failure-handling software. Process I/O software is organized as a collection of tasks, in functionally self-contained, highly independent sections of code. The operating system schedules tasks in response to real-time events, such as interruptions from external devices, clock pulses, or messages from other tasks. Semaphore and mailbox constructs in the real-time operating system provide synchronization of tasks and sharing of resources.

Intel Corp.'s RMX-86 Real-Time Executive multi-

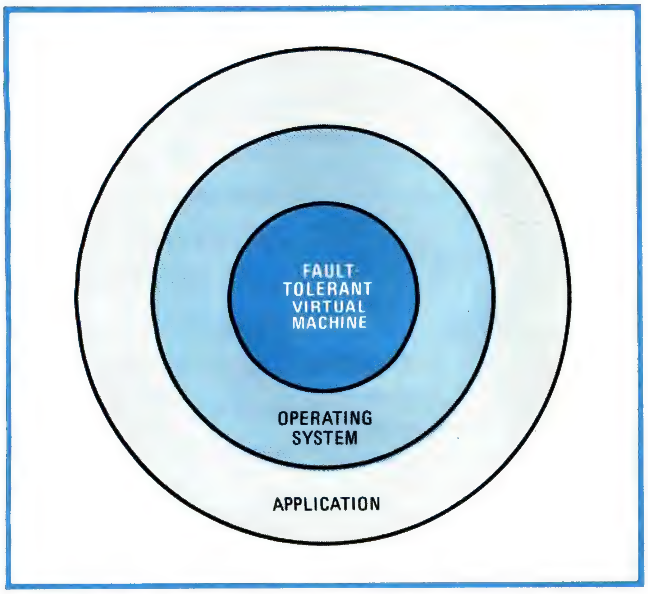


3. Redundant system. The major components of each subsystem—random-access memory, the central processing unit, the packet-switching interface, and I/O expansion—are isolated and communicate over a Multibus backplane. The I/O expansion chassis can accept up to 1,024 inputs.

tasking operating system monitors task activity and arbitrates requests for processor time and other resources—and it does it in a manner largely invisible to the tasks. It also supplies the mechanisms to provide for communication and synchronization among tasks, to monitor and service external interruptions, to access the system clock, and to communicate with external peripherals without requiring tasks to be aware of their physical characteristics.

The real-time characteristics of the multitasking operating system dictate that a task in the process I/O software must operate asynchronously, except when explicit communications and cooperation are required. Since the software is decomposed in this way, the job of coding and testing becomes simpler because the task modules are small and functionally isolated. This produces a more robust and flexible implementation.

Another major simplifying feature of this software is its table-driven organization. A large portion of the code is dedicated to interrogating data tables in response to specific real-time events and obtaining the parameters required for the next activity of the process I/O system. This means that all vital information is readily available and observable in the data tables, an important feature that contributes substantially to the software's overall quality.



4. Software for safety. In the system software, a matrix-isolation technique is used to isolate faults. Two independent software systems check each other, and if a fault is detected, testing is repeated, thereby eliminating transient errors.

The application module

The application module is made up of the several tasks responsible for receiving and decoding X.25 messages from the central computer, managing the devices in the stations, device time-out, sending messages to process I/O subsystems, and preparing and delivering messages to the central computer. The tasks in this module are independent of one another but share common data. Tasks are scheduled either by a real-time clock or by other tasks. All task scheduling and resource sharing is coordinated throughout the operating system.

Finding a failure is really a three-step process: detecting, diagnosing, and then reporting a process I/O failure—and doing these things in a background mode at a low priority, executing when there are no application tasks to be performed. When no central-computer commands are pending in the input queue and there are no device commands to be built, a low-priority self-checking task runs, verifying the operational status of the process I/O hardware and the data base. Self-checking involves a nondestructive processor, memory, and I/O subsystem checks. The serial link is used to exchange and cross-check critical parameters. If an error is detected, an analysis task is scheduled to determine the error source. This task builds a message, which is moved to the X.25-output task mailbox for transmission to the central computer. Failure detection is performed by a hierarchical checking mechanism. In this manner, it is very unlikely that an error will go undetected. □

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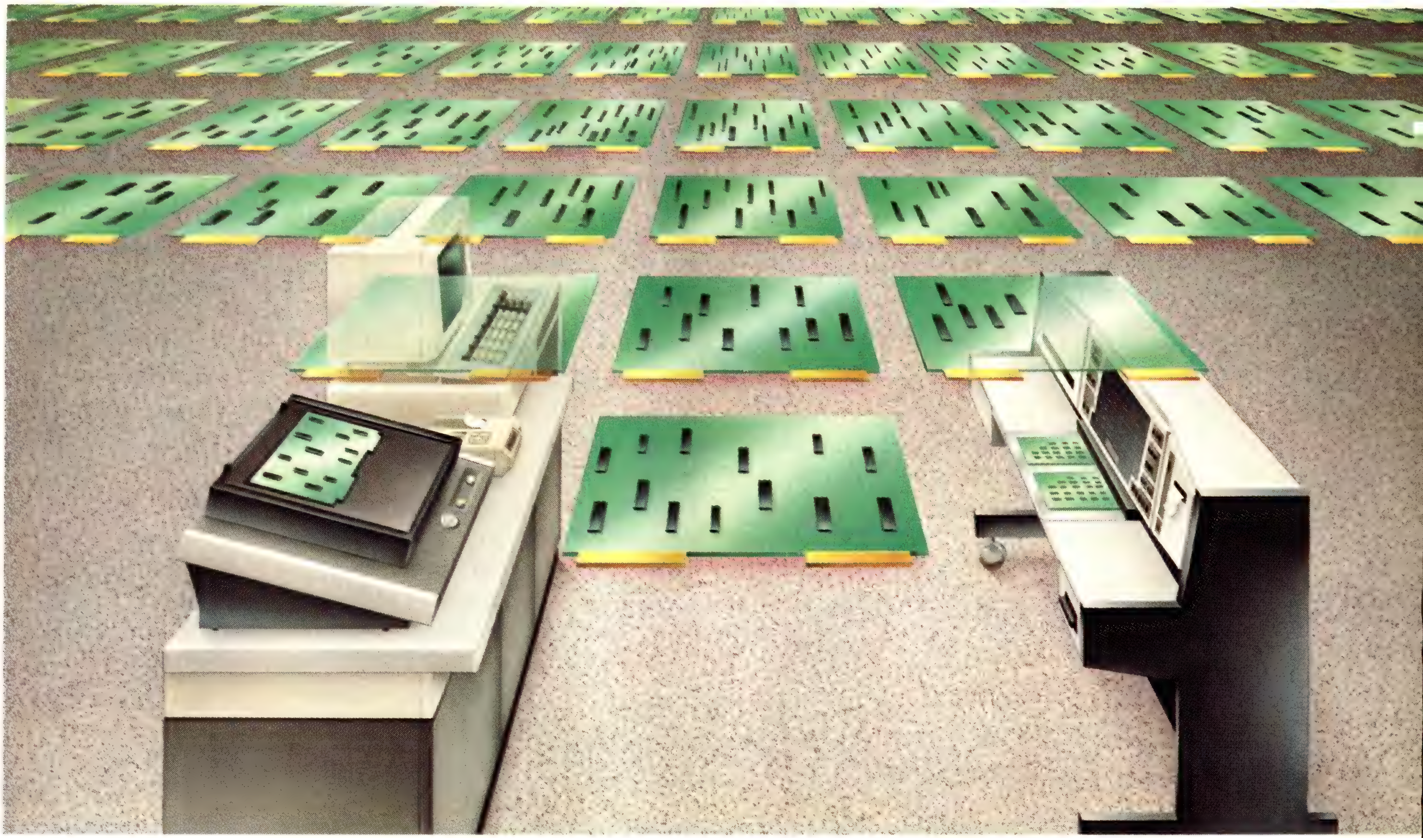

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Engineer's newsletter

Catalog specifies guidelines for designing magnetic shields

A new catalog and engineering manual from Ad-Vance Magnetics Inc. could be very useful for engineers who must design or choose the best possible kind of magnetic shielding for a given application. The 84-page publication has three engineering sections, which include 30 pages of **reprinted articles that Ad-Vance's engineering staff wrote to help fill the gap between users and electromagnetic-interference specialists.** In addition, 13 pages are devoted to 25 case histories of magnetic-shielding problems and solutions. For a free copy, get in touch with Richard D. Vance, president, Ad-Vance Magnetics Inc., 625 Monroe St., Rochester, Ind. 46975 or call (219) 223-3158.

Directory of computer graphics lists 500 sources

If you have an interest in computer-graphics hardware, software, systems, or services, the "S. Klein Directory of Computer Graphics Suppliers" (third edition) should be useful. This latest, 224-page edition identifies more than 500 supply sources. For each company, the directory provides basic product and background information, including ownership, top management, company size, and sales volume, as well as the company's address, telephone number, telex or TWX, and the person to get in touch with for further information. In addition, **the directory has a computer-generated cross index to help readers identify vendors by applications of interest and by specific technologies**. The directory costs $60; add $10 for overseas airmail. To order, get in touch with the Directory Manager, Computer Graphics Suppliers, 730 Boston Post Rd., P. O. Box 89, Sudbury Mass. 01776.

NBS announces noise standard for millimeter-wave systems

Using a horn antenna, scientists at the National Bureau of Standards have developed the first national-reference noise standard in the millimeter-wave region. **This cryogenic-noise standard, in the range of 75 to 110 GHz, will help industry and Government agencies promote the development and evaluation of critical components for millimeter-wave systems.** A major step in the development of noise standards, it will be useful in communications, defense, and aerospace applications. "Design and Error Analysis for the WR10 Thermal Noise Standard" (TN 1071) gives details on the design and construction of the waveguide horn antenna and isothermal cavity that serve as the noise-power standard. The publication is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Order by stock number 003-003-2538-1.

Components attach to polymer conductors in three ways

Polymer thick-film conductors are a good low-cost alternative to plated or etched copper conductors on printed-circuit boards. But they are not solderable, and attaching surface-mounted components to them is very difficult. At a February International Electronics Packaging Society workshop in Anaheim, Calif., **William J. Green of Methode Development Co. discussed three methods his firm is studying in hopes of making polymer thick-film conductors easier to use.** One is to prepare the polymer surface with electroless plating, either copper or nickel; the second would be to prepare the polymer surface with a solderable polymer; and the third would be to eliminate solder entirely and apply a conductive adhesive. The first method requires no new technology; the other two await the development of new materials. **–Jerry Lyman**

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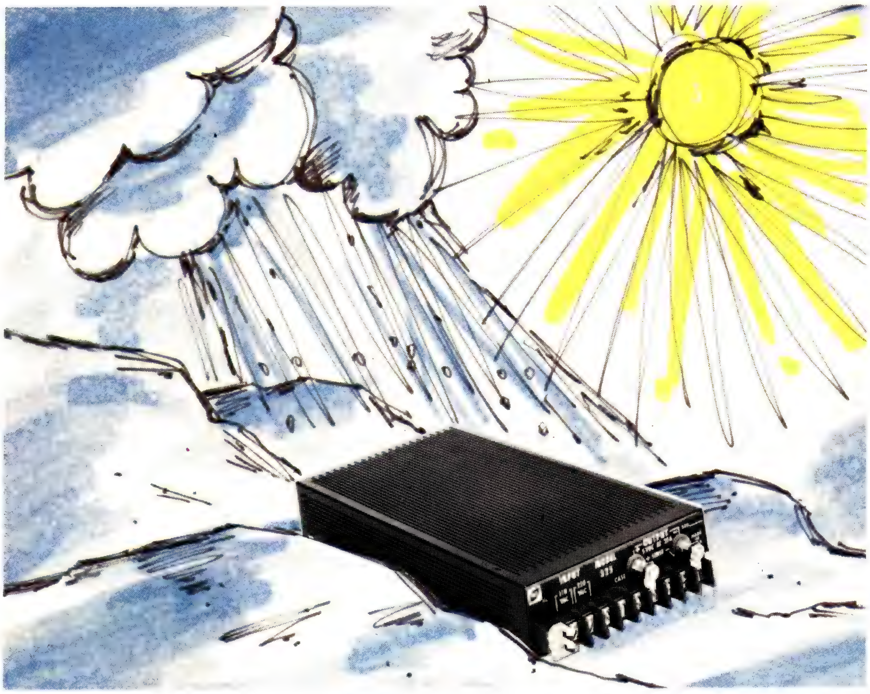

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STATE TABLE DISPLAY: ACQUISITION                 COMPARE: START SEQ   0
                                                          STOP  SEQ 100
TRIG =   00000  0000  0000
SRCH =   XXXXX  XXXX  XXXX

SEQ           80186 HARDWARE                    80186 SOFTWARE

 71     F9093   JNE    F90AA               F9093   JNE    F90AA
 72     00181   01     ( I/O READ  )
 73     F9094   15     ( FETCH     )
 73     F9095* ADDW    DX,#**02
 74     F9096*  C2     ( FETCH     )
 74     F9097*  02     ( FETCH     )
 75     F90AA   FF     * ILLEGAL *         F90AA   FF     * ILLEGAL *
 75     F90AB   FF     ( FETCH     )       F90AB   FF     ( FETCH     )
 76     F90AC   STL                        F90AC   STL
 76     F90AD   POP    DX                  F90AD   POP    DX
 77     F90AE   RET                        F90AE   RET
 77     F90AF* PUSH    DS
 78     F90B0* PUSH    CS
 78     F90B1*  POP    DS
 79     003F0   F000   ( MEM READ  )       003F0   F000   ( MEM READ  )
 81     003F2   8390   ( MEM READ  )       003F2   8390   ( MEM READ  )
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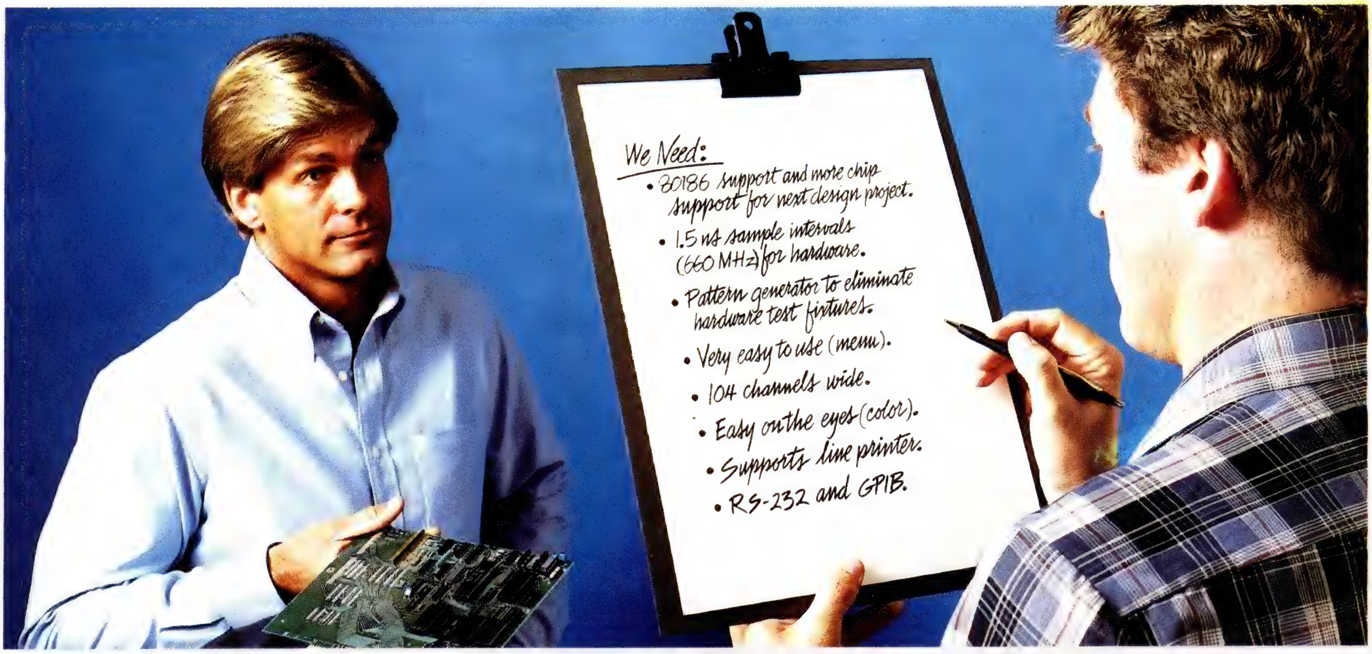
You do.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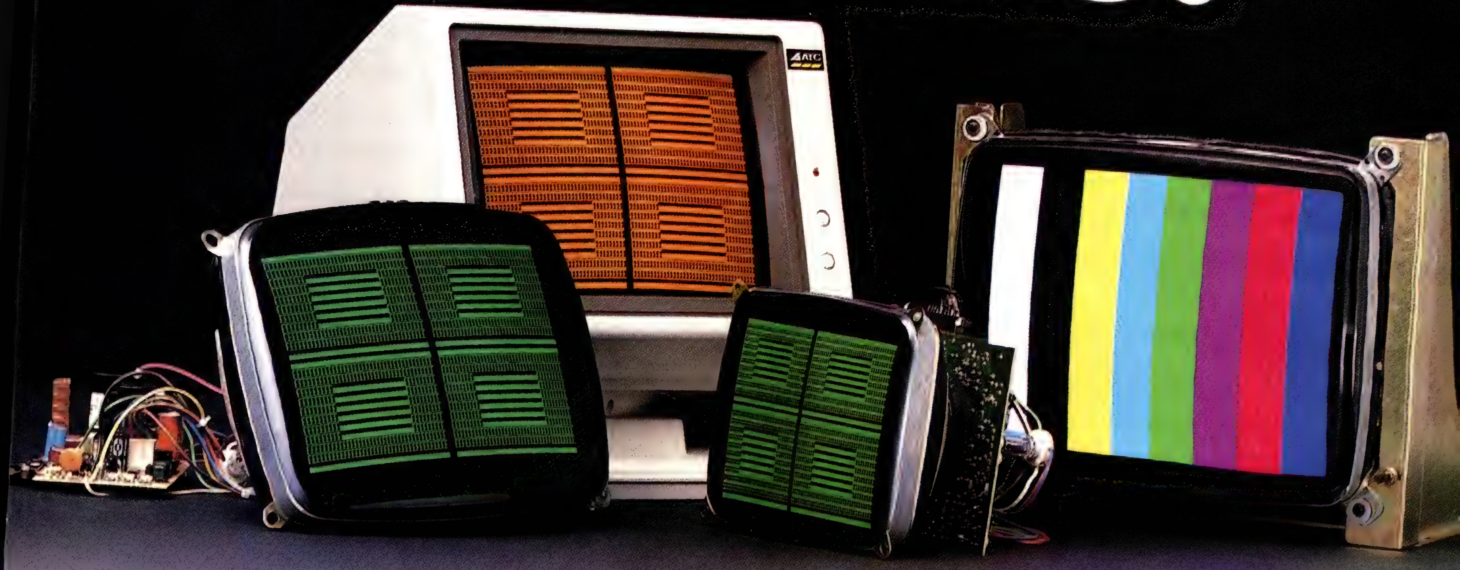

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New product previews

Introducing noteworthy hardware and software

Cards let a PDP-11 work like a VAX

32032-based Q-bus processor card and memory card upgrade PDP-11s with floating-point arithmetic, Xenix, and 16 megabytes of virtual memory

by Clifford Barney, San Francisco regional bureau manager

Although limited to 16-bit processing power and 64-K bytes of address space, the venerable PDP-11 computer is still used widely, in part because of its many peripherals and software applications. For less than $7,000, a new board-level product from start-up American Information Systems Inc. promises to give the PDP-11 renewed life as a dual processor based on a Unix-like operating system, with more power than a VAX, its younger superminicomputer cousin.

National Semiconductor Corp.'s 32032, the first full 32-bit microprocessor to hit the market [*Electronics,* March 8, p. 97], is the foundation of the AIS/3210 system. The 32032 can address 16 megabytes of demand-paged virtual memory, accessed over a 32-bit high-speed backplane bus that AIS developed. AIS says that the fast memory—with access times of 100 ns—can run at 14 MHz without wait states. The system also includes a National 16082 memory-management chip and a 16081 floating-point-processor chip.

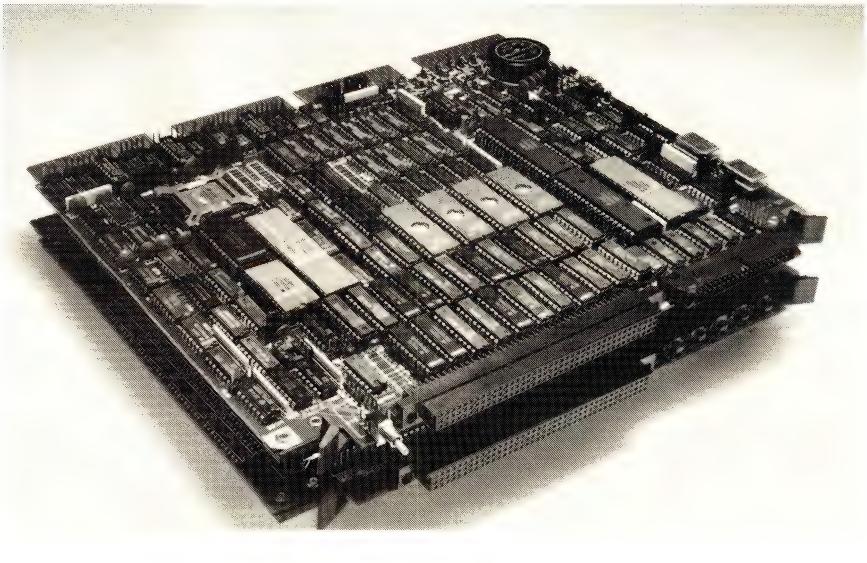
One or more processor boards and memory boards from AIS plug directly into a 16-bit Q bus. To a PDP-11, the 3210 is a Q-bus module with a 32-bit central processing unit, a floating-point capability, hardware-implemented virtual memory, and a Unix-based operating system. To the 3210, the PDP-11 is a sophisticated input/output processor with a wealth of available peripherals, which can be linked directly to the AIS memory. The PDP-11 runs all its regular software but with the enhanced performance of the 32032; the AIS system operates Unix applications under Xenix 16K, Microsoft's version of AT&T Bell Laboratories' Unix, ported to the National 16000 family. AIS chose Xenix because its enhancements make it useful in multiuser business environments.

AIS estimates that some 300,000 PDP-11s are now in use and that many of their owners are hungry for performance like a VAX but gag at the $250,000 price tag. Glenn Leedy, president of AIS, who worked on the original VAX software design team at Digital Equipment Corp. and then on software products for the National 16000 family, says that mating a sophisticated microprocessor with the PDP-11 is a quicker and more cost-effective way of gaining performance than shrinking an established minicomputer onto a chip. "This way we can give the customer what he has always wanted—high performance and lots of memory at a reasonable price," Leedy says. Future versions will be available for Multibus and Unibus systems.

The number of processors that can be installed in a Q-bus system depends on how many slots are available—and all can operate independently. AIS offers two versions of the 3210. In one, the AIS board becomes the main processor on the Q bus; in the other, the AIS board or the PDP-11 processor becomes bus master. In the latter version, the two processors can operate concurrently while sharing peripherals, but the PDP-11 or another AIS board controls all Q-bus I/O. In either configuration, the PDP-11 will continue to run all its own software. Under Xenix, the AIS/3210 supports Basic, Fortran-77, PL/1, Cobol, and Pascal.

Virtual I/O. For interprocessor communications, AIS has developed a virtual I/O system (VIOS), which allows Xenix to call for service from the I/O drivers of any host. In effect, the VIOS contains a generalized I/O message protocol that is independent of the operating system, enabling all AIS service calls to be directed to virtual rather than to real devices.

A CPU board for the 3210 costs



$3,600. A basic 500-K-byte memory board costs $2,400, a double board with 1 megabyte of memory $3,600. The Xenix operating system can be licensed for $800. The 3210 will be available in July of this year.

American Information Systems Inc., 1801 Page Mill Rd., Palo Alto, Calif. 94304. Phone (415) 494-3210 [Circle reader service number 338]

Parallel architecture permits computer to do 341 million floating-point operations/s

About 75% of all scientific calculations involve solving large sets of simultaneous equations. These are represented as matrices, and the calculation combines their rows and columns, point by point. Floating Point Systems has developed a highly parallel architecture that allows its FPS-164/MAX system to operate on entire rows or columns (vectors) simultaneously, thus achieving supercomputer-range performance.

A fully configured 164/MAX system computes as many as 124 vectors at a time and can factor a 1,000-by-1,000-element matrix in 1 s, multiply two 10,000-by-10,000-element matrices in less than 1 h, and reach peak performance rates of 33 million to 341 million floating-point operations/s. The Cray 1 supercomputer is rated at 160 million floating-point operations/s.

Least expensive. The 164/MAX outperforms the Cray only on certain key matrix operations in which there is much regularity in the vectors. For computing scalars (single points), the system is rated at 11 million floating-point operations/s. Nevertheless, the 164/MAX's price tag—which ranges from about $450,000, for a version able to perform 33 million floating-point operations/s, to just under $1 million, for one that can perform 341 million floating-point operations/s—makes it the least expensive supercomputer. Floating Point Systems says that operating the machine, including amortization and personnel, costs less than $60/h, based on a 12-h day.

The 164/MAX achieves high performance without high-speed components: it is built with standard Schottky TTL logic and 200-ns 64-K memory chips. Its machine-cycle time is 182 ns. The keys to the system's performance are its architecture, its memory organization, and a set of proprietary very large-scale integrated floating-point processors. Floating Point Systems designed the computing algorithms for its 164/MAX system so it would work as a parallel copy of the company's basic machine, the FPS-164, which can perform 11 million floating-point operations/s.

Since standard memory and logic chips were used, the architecture had to avoid memory and input/output bottlenecks. Memory is organized in tiers: first a set of 64 very fast registers, with essentially zero access time; then a memory table to store reused vectors; then main memory, 7.25 million words of 64-bit memory in the chassis, with the rest of the 16 million-word addressable memory on disk. Built by Control Data Corp., the disk is a 135-megabyte system with a 1.2-Mb/s transfer rate. When 256-K memory chips become available, all 16 million words will reside in main memory.

The main memory's top million words are used for the arithmetic elements. Available operations are dot product, vector/scalar multiply and add, vector multiply/scalar add, and their subsets. The operands can be real or complex data, and the vectors can be contiguous or sparse.

Each vector is written by a single VLSI multiply or add processor, but all arithmetic processors are slaved to the central processing unit. To achieve parallel operation, the CPU broadcasts data to all memory boards at once. The system can operate on matrices as large as 124-by-2,000 elements. Floating Point says that the 164/MAX configuration becomes cost-effective for multiplying 20-by-20-element matrices.

The 164/MAX system can be built from its predecessor, the FPS-164, for about $100,000 if two boards are replaced and others modified. Both International Business Machines Corp. and Digital Equipment Corp. will market the 164/MAX with their own equipment as options for fast floating-point matrix calculations. The system also operates with networked Apollo Domain work stations to help designers perform stress analysis in their computer-aided-engineering and -design work.

The firm anticipates applications in chemistry, physics, aerospace, and seismic and oil exploration as well, and expects the system to replace larger supercomputers in many of them. The basic system, with a fast-matrix-solution library for use in table memory, is available now; the VLSI processor chips will not come on the market until year end.

Floating Point Systems Inc., 3601 S. W. Murray Blvd., Beaverton, Ore. 97223. Phone (503) 641-3151 [Circle 339]

Data base needs no query syntax

Targeted initially for VAX minicomputer environments, the X-ample relational data base can meet the needs

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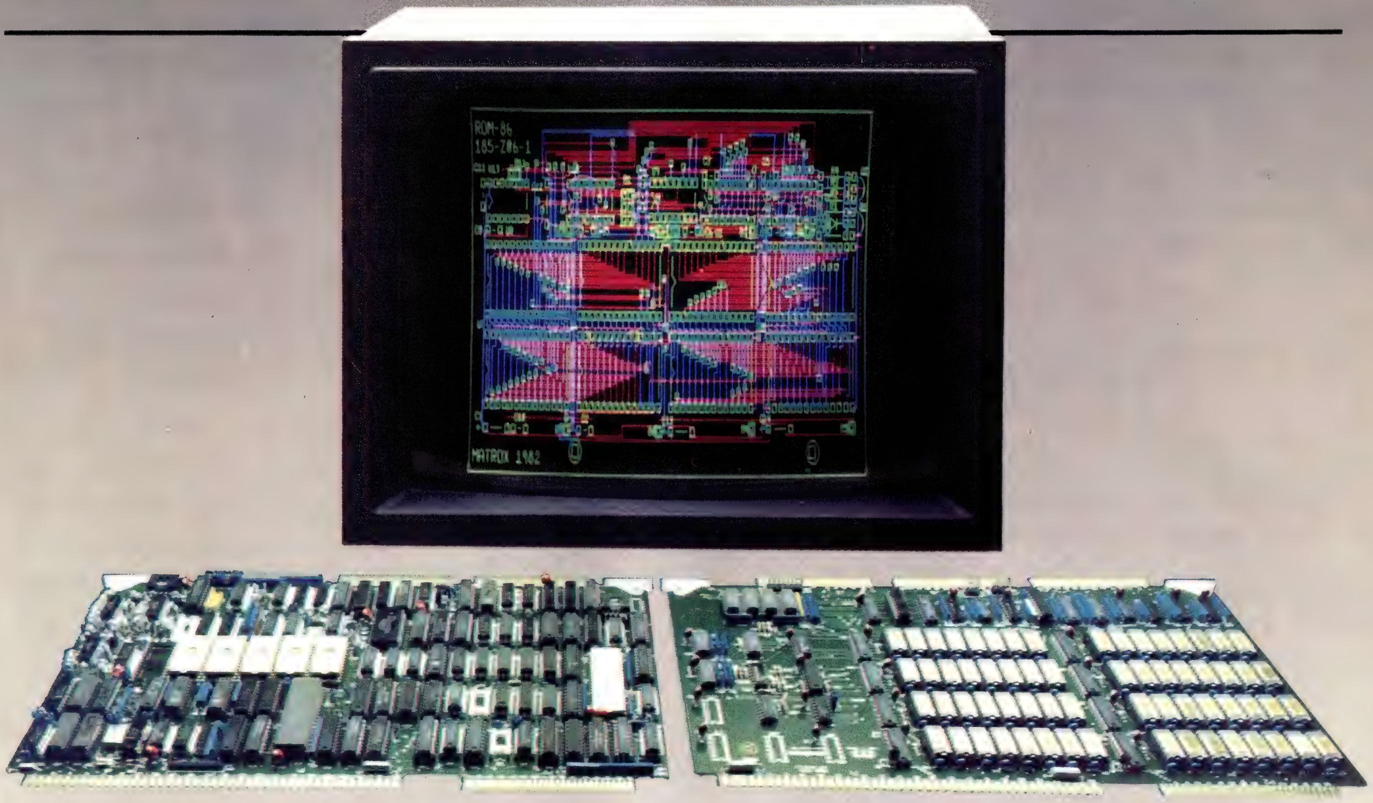

MATROX GXB-1000 - The complete color graphics solution.

DISPLAY RESOLUTION: 1024 x 768 pixels non-interlaced at 60Hz or up to 1600 x 1200 pixels interlaced at 30Hz

READ/WRITE AREA: 1024 x 1024 x 4 bits/pixel expandable to 1024 x 1024 x 16 or 2048 x 2048 x 4

SPEED: Four pipelined on-board processors draw graphics primitives at speeds of 50 to 800 nsec/pixel

COLOR: 16 display colors can be selected from a palette of 256 different shades

SOFTWARE: On-board 16 bit CPU with resident graphics software interprets over 256 commands and supports local segments, 2D primitives, tablet tracking, rubber banding, etc.

MODULARITY: GXB-1000 is fully Multibus compatible (IEEE-796), and operates from a single + 5V supply

Multibus - TM Intel *QTY 100

The GXB-1000 is a complete color graphics display system implemented on two Multibus boards. The system executes a display file containing high level graphics commands, generated by the user's host CPU. The GXB-1000 includes all the necessary hardware and software to draw lines, polygons, circles, characters, etc.

The GXB-1000 represents true state of the art performance. The boards generate the highest display resolution available from a raster scan device. The multi-processor pipelined architecture provides the highest possible drawing speeds.

Over six man years of Matrox programming effort have gone into the development of the on-board graphics software. An extensive command set allows the user to construct complex images with a minimal number of host CPU instructions and time.

The unmatched performance and low cost of GXB-1000 make it the perfect solution for OEM color graphic displays. Additionally, Matrox can provide RGB monitors, CPU boards, memory boards, cardcages and keyboards for complete display system requirements.

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of nontechnical users and data-processing professionals alike. Unfettered by such technical problems as access paths and data restatements, business or professional managers can use the software to set up data bases for their organizations. Yet the program also has the extensive functionality that systems people need to implement and integrate a broad range of applications for users with diverse requirements.

Users do not have to learn the syntax of a query language to use X-ample, which is driven entirely by options selected from screen menus. Nor do they have to define the architecture of a data base before entering data; the program guides them through the process of defining entities (record types) for classes of data and the attributes of those entities (record fields). Users can then proceed with data entry, putting off the development of architectural schemes and relationships among entities until they are needed.

The product will be available in two forms. Nontechnical managers can use X-ample I to create and implement their own data bases; this version of the program handles only a single data base, although it could have up to 500 entities. Managers can also develop a number of prototype data bases, and systems professionals can then use X-ample II to integrate them into a single system comprising up to 500 separate data bases with a common data dictionary.

Any time. X-ample lets users create relationships at any time, without relating the common data within entities. In other words, users can relate entities with a certain value for an attribute to entities with another specified value in a completely different attribute. They can set up relationships among entities that do not have matching attributes: one-to-one, one-to-many, and many-to-many relationships.

In querying the data base, users create what are called logical views of the data, including selection criteria and the attributes chosen for display, as well as relationships if desired. X-ample automatically determines the best path to access the requested data: unlike many systems, it does not rely on users to define efficient paths.

The program provides nine levels of privilege. As a data base is created, the system manager designates a privilege level for reading, writing, changing, or deleting functions. Privilege levels can be assigned for each attribute of each entity. When a user's identification code is established, the manager enables selected functions and gives that user a privilege level. The data base can thus be set up so that each user can perform some functions on some attributes of selected entities within specified data bases.

X-ample, which also sports data-validity checking and remote access, was originally intended to complement its developer's set of accounting software products, called Dolars, to assist in inventory, property, tenant, lease, and asset management. The data-base packages are by no means limited to use in those areas.

X-ample I will be available for Digital Equipment Corp. VAX systems in June at prices ranging from $12,000 for the VAX-11/725 to $25,000 for the VAX-11/785. X-ample II for the VAX will be available in September, and the product will be brought up on Hewlett-Packard's 3000 line of minicomputers by the end of the year, according to the firm.

Landmark Software Systems, 155 W. Main St., Somerville, N. J. 08876. Phone (201) 722-5100 [Circle 342]

Software puts Perq systems on Ethernet

"What we are trying to do is change our image completely from a company that sells engineering work stations to a company that sells distributed computing networks that contain work stations, as well as other hardware and software," observes Aaron Coleman, president of Perq Systems Corp.

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Our multipliers, for example, offer 2 micron capability in 8 × 8, 12 × 12 and 16 × 16 configurations. They're plug-compatible with existing TRW or AMD bipolar parts, pin for pin.

You can order them in commercial and military temperature ranges, including 883B screening. And, of course, in ceramic or plastic packages.

And you can order them right now. Through us or our distributor, Diplomat.

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LMU08	8 × 8 Bit	60 mW	65 ns	MPY-008H
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LMU12	12 × 12 Bit	100 mW	80 ns	MPY-012H
LMU13	12 × 12 Bit Microprog.	100 mW	80 ns	—
LMU16	16 × 16 Bit	125 mW	100 ns	MPY-016H AM 29516
LMU17	16 × 16 Bit Microprog.	125 mW	100 ns	AM 29517
	REGISTER FILE			
LRF08	8 Bit Multiport	60 mW	25 ns	—

*Typical

Take a look at the chart below and you'll see how our low power, high speed multipliers stack up against the competition. (We also feature a 25 ns, 60 mW multiport register file — a necessary component for future Signal Processing systems.)

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However, to compete successfully in today's redhot Signal Processing market we'll have to offer more. Toward that end, we'll soon be producing an entire family of high-performance CMOS bit-slices and ALU's.

For further information on the only company dedicated to CMOS VLSI for genius Signal Processing and the facts on our family of multipliers, call our Marketing Department at 408/720-8630. Or write, 628 East Evelyn Avenue, Sunnyvale, CA 94086, Telex: 172387.

You'll find that the company who marches to the beat of a different drummer is playing your song.

LOGIC
DEVICES INCORPORATED
The Genius in CMOS Design.

Circle 165 on reader service card

company's maneuvering comes this week at the Computer Graphics 84 show, in Anaheim, Calif., where Perq is set to unveil a new distributed operating system designed to allow totally transparent resource sharing among Perq work stations on a network. The second step is a work station equipped for artificial-intelligence applications.

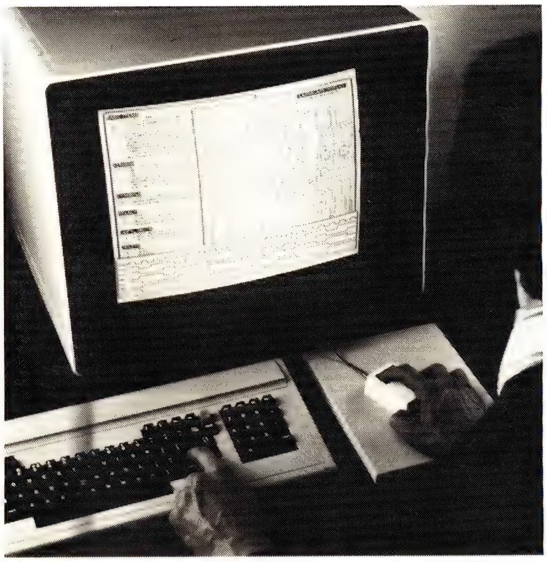
The Accent operating system, which was developed at Carnegie-Mellon University, comes to Perq under the terms of a technology-transfer agreement [*Electronics,* April 19, p. 42]. It will run on such Perq work stations as the recently upgraded Perq 2 [*Electronics,* Feb. 23, p. 168], and the stations will be linked through an Ethernet-compatible local network Perq calls LINQ. The system's network capability is expected to make Perq more competitive with such work-station vendors as Apollo Computers Inc. and Sun Microsystems Inc., both of which already offer distributed networking systems.

Accent is a message-based communications-oriented operating system that Perq says was designed from the ground up with a distributed-network operating environment in mind. The result is a system that lets processes execute on multiple machines in the network with no degradation in response time, says Scott Os, Perq's advanced product-planning manager.

Unlike some other systems, Accent does not require users to know where data files or peripherals reside in the network or to enter special commands in order to access them, Os explains. Similarly, response times will typically remain constant as users are added to the system.

A maximum of 1,024 work stations can be tied on any one segment of the baseband, 10-Mb/s LINQ network. Connections to multiple segments and to other Ethernet-based systems are available as well.

A key to Accent is its kernel, which provides low-level support for the operating system by managing interprocess communication. Unlike traditional operating systems, which usually provide complete functions, Accent breaks functions down and manages them separately by passing messages both synchronously and asynchronously to the kernel, Perq officials say. The operating system activates its other functions by sending messages through the kernel to the appropriate server process.



Does windows. Accent's features include a high-level window manager and graphics-support system that allow overlapping windows, with access to as many as 64 windows on a screen. An associated editor allows information to be transferred among windows; up to nine files can be edited simultaneously.

Accent supports the C, Perq Pascal, Fortran 77, and Perq Lisp programming languages. An AT&T Bell Laboratories' Unix System V compatibility package licensed from the communications giant is also available as an option to implement System V system calls and utilities. Accent will provide upward compatibility for current Perq customers, so Perq work stations running the company's older POS operating system can use the network and share files with Accent-based work stations, Os says.

Accent is set for shipment in July. Perq then promises a series of additional products and services that are designed for use on the LINQ network and will run in the Accent environment. These additions are expected to include various network print-and-file service capabilities, mainframe and minicomputer links, and specially configured Perq work stations.

One such work station, Perq's AI, is scheduled for unveiling during this week's show. Also known as the model LN3500, it will be available in July and will consist of a Perq 2 work station optimized for AI applications.

Equipped with a microcode instruction set designed to take advantage of the work station's bit-slice architecture for high-performance AI work, the Perq AI will come with bundled software consisting of Accent, a C compiler, and Perq Lisp, the company's implementation of common Lisp language. The Perq AI configuration will include a 19-in. "landscape" display (one that is wider, with 1,280 picture elements, than it is high, with 1,024 pixels), 2 megabytes of main memory, a 43-megabyte Winchester disk drive, and LINQ network support.

The Perq AI will sell for $39,495 each. The AI software package will also be available separately for a site-license price of $39,950, which will let it be used on as many as 100 work stations at a single user site.

The Accent operating-system software will be available unbundled for Perq work stations at a single-node price of $750 per work station or (for use on up to 100 work stations at a site) at a site-license price of $9,950. Pascal, Fortran 77, and C compilers will also be available at $995 per compiler for single-node applications or at a site-license price (again for up to 100 work stations) of $9,950 per compiler.

Accent and the other new software offerings are set for July availability. Perq 2 work stations—priced from $17,900 to $29,000 in 100-unit quantities, depending on the configuration—must be purchased separately.

Perq Systems Corp., 2600 Liberty Ave., P. O. Box 2600, Pittsburgh, Penn. 15230. Phone (412) 355-0900 [Circle 341]

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Is it really possible?

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LEDs have always had many outstanding features like long life, wide operating temperature range and direct interface capability with IC's... advantages that other display technologies lack.

But there has been one drawback. The power requirement of LED displays has made them less than ideal for portable instrumentation and other low power applications.

The LightHouse decided to confront the problem. Would it be possible to combine the benefits of LEDs with the low power consumption of liquid crystal displays?

General Instrument's R&D took on the challenge.

Today they've created a minor miracle: the MAN 6100 series low-current LED displays.

These digits offer the same typical brightness at 2mA that popular conventional displays do at 10mA.

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They enhance system reliability.

They use standard dual in-line pin configurations that don't require any special mounting fixture.

And if you really want bright displays, you can drive them at 7.5 mA to get four times the brightness of widely used red LED digits.

Part No.	Description
MAN6110	2 Digit; Common Anode; Rt. Hand Decimal Point
MAN6130	1½ Digit; Common Anode; Overflow ± 1.8. Rt. Hand Decimal Point
MAN6140	2 Digit; Common Cathode; Rt. Hand Decimal Point
MAN6150	1½ Digit; Common Cathode; Overflow ± 1.8. Rt. Hand Decimal Point
MAN6160	Single Digit; Common Anode; Rt. Hand Decimal Point
MAN6175	Single Digit; Common Anode; Overflow ± 1. Rt. Hand Decimal Point
MAN6180	Single Digit; Common Cathode; Rt. Hand Decimal Point
MAN6195	Single Digit; Common Cathode; Overflow ± 1. Rt. Hand Decimal Point

One more thing. We made the MAN 6100 digits extremely cost-effective by pricing them *exactly the same* as General Instrument's 0.6" high efficiency red LED displays.

General Instrument's MAN 6100 low power 0.6" displays are currently offered in high-efficiency red. 0.3" digits will be available in the near future, and other colors are planned.

Call our sales reps or distributors for samples and literature. Or contact General Instrument, Optoelectronics Division, Dendermondsesteenweg, 502C, 9120 Destelbergen, Belgium. Tel. 091/28.88.00. TELEX–12686

GENERAL INSTRUMENT
Optoelectronics Division
The LightHouse people depend on.

Circle 168 on reader service card

Instruments

Logic analyzer features state, timing analysis

Besides providing the functions of the earlier HP 1630A and 1630D, the HP 1630G logic analyzer offers extended software-performance analysis, as well as state- and timing-analysis capabilities. In addition, the 65-channel HP 1630G is well suited to applications involving 16-bit microprocessors and multiple-bus monitoring.

The HP 1630G offers 57 channels for state analysis and 8 that can be used for either state or timing analysis. Users can store an inverse assembler plus one setup configuration in the analyzer's programmable nonvolatile memory. What's more, when the unit is in the state-analysis mode, its state-analysis time-tagging capability lets users measure the time between each stored state.

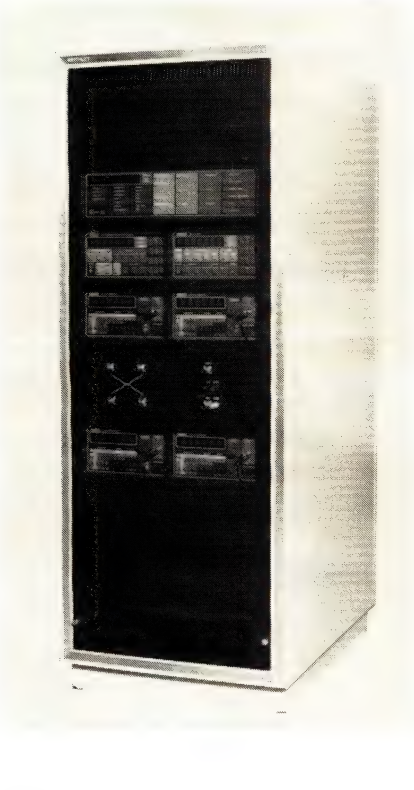
A histogram function lets the logic analyzer show users which parts of programs take most time to execute. With time-positional management, users can measure the frequency with which a state occurs in a given unit of time. Linkage measurement gives the relative frequency with which sets of state pairs occur.

Priced at $12,100, the HP 1630G can be delivered within four weeks.

Hewlett Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle reader service number 351]

System tests wide band-gap semi-insulating chip materials

The Keithley system 100 is a computer-controlled test system for Hall-effect studies and resistivity/mobility measurements taken with the van der Pauw method. It is designed to evaluate gallium arsenide and other wide band-gap semi-insulating semiconductor materials.



The system consists of the company's instrumentation package and an IEEE-488 interface suitable for control by a number of computers. With an overall input resistance greater than 10^{13} Ω, the system meets this test technology's high-impedance low-level measurement needs.

The package includes five programmable electrometers, a current source, and a 20-channel scanner mainframe with current- and voltage-scanner cards.

Priced at $35,000, system 100 is available now.

Keithley Instruments Inc., Systems Division, 28775 Aurora Rd., Cleveland, Ohio 44139. Phone (216) 248-0400 [Circle 354]

Hand-held instrument tests RS-232-C interface circuits

The model 2020, a hand-held device that diagnoses problems in modem-terminal interface circuits, measures voltage values as well as voltage positive and negative states. Users can transparently insert the tester into any kind of digital-terminal-equipment or digital-communications-equipment interface conforming to RS-232-C specifications.

The part incorporates three-state light-emitting-diode displays that emit a red signal for levels of +3 V or more and green for levels of –3 V or more; the displays are not lit between +3 V and –3 V.

The tester costs $199, and delivery is from stock.

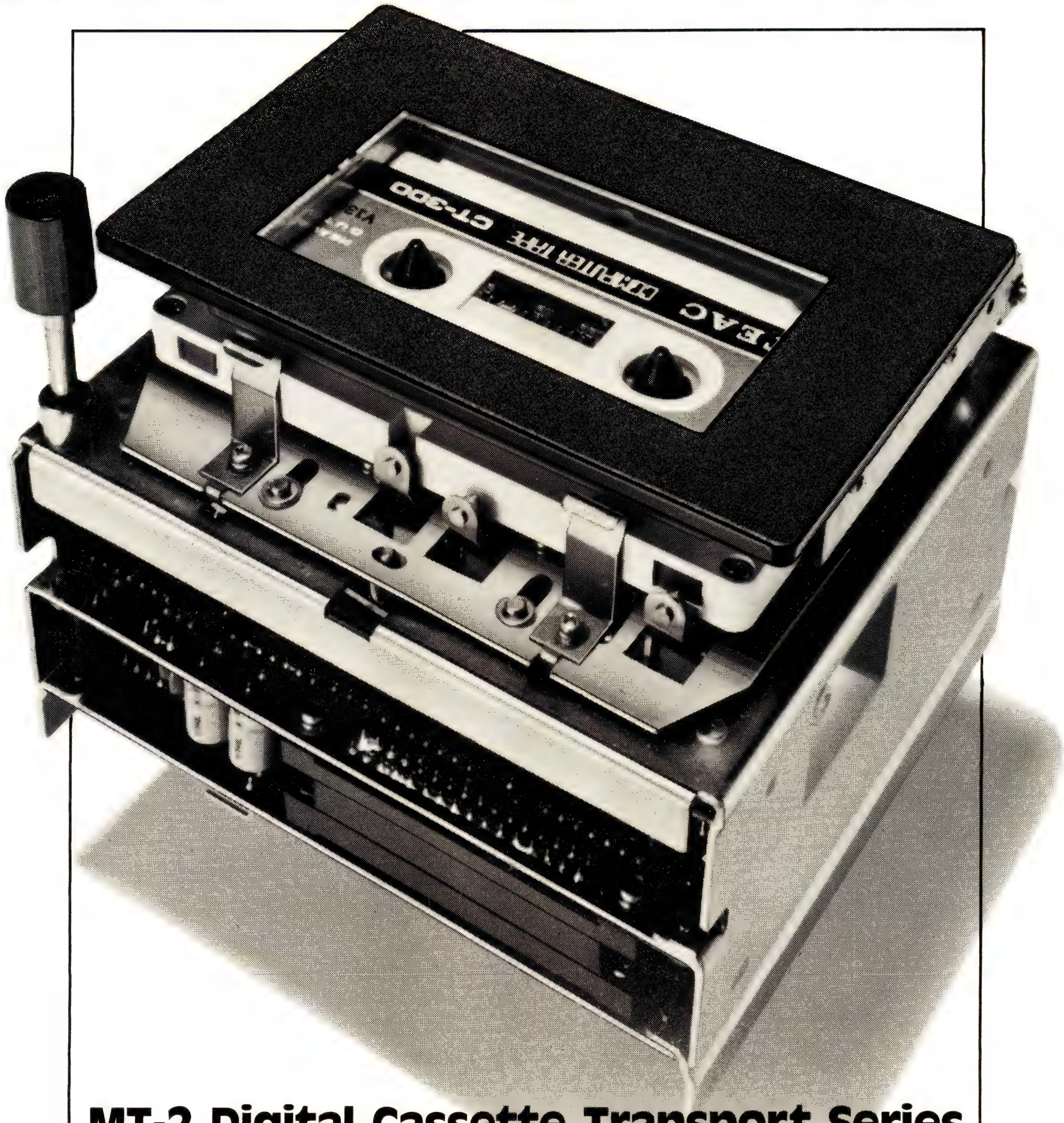
RSV Electronics Inc., P. O. Box 87, Circleville, N. Y. 10919. Phone (914) 692-2703 [Circle 358]

Microwave meter responds in 25 ms, is accurate to ±0.5%

The 6960 microwave power meter provides such functions as automatic ranging, calibration, and zero averaging time, as well as power-up mode selection, power linearity correction, and *full* IEEE-488 compatibility. Users can choose response speeds as fast as 25 ms.

The microprocessor-controlled digital meter almost eliminates zero

HIGH CAPACITY



MT-2 Digital Cassette Transport Series

TEAC's MT-2 digital cassettes provide high data capacity in a compact unit. Six different models are available, allowing a whole range of OEM applications. The MT-2_{23} and MT-2_{24} are 2-track, double-density models that allow both sides of the tape to be used without turning the cassette over. Four 1-track, single-density models are also available, MT-2_{01}, MT-2_{02}, MT-2_{03}, and MT-2_{04}. Models MT-2_{24}, MT-2_{02}, and MT-2_{04} come complete with a built-in LSI controller, which allows simple connection to the system bus lines of popular microprocessors such as the 8080, 6800 and Z-80.

MT-2_{23} , MT-2_{24} Main Features

- Two tracks
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- Read/write 15 ips, high-speed search 45 ips, rewind 75 ips
- 24,000 bits/second data transfer rate
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- Read/write both sides of the tape without turning cassette over

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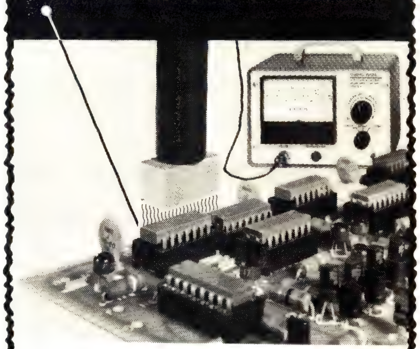

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drift and range errors. Supported by comprehensive self-checking and diagnostic features, the meter is accurate within 0.5%.

With an offset facility, users can display actual transmitter powers directly on the 6960. They enter the precise values of intervening attenuators or couplers through the keyboard and thus eliminate many common arithmetic errors.

Available within 45 days, the model 6960 costs $2,550.

Marconi Instruments, 100 Stonehurst Ct., Northvale, N. J. 07647. Phone (201) 767-7250 [Circle 352]

Storage oscilloscope digitizes at 20-MHz in real time

The 4030 digital-storage oscilloscope features a 20-MHz real-time digitizing rate, which helps it capture medium-to-high-frequency input. It is therefore suitable for test applications ranging from power supplies to telecommunications.

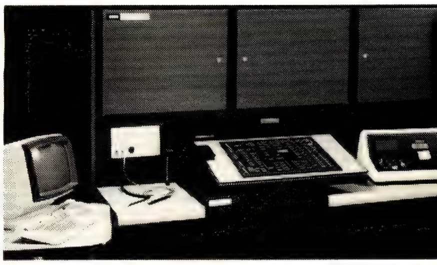
By pressing a button, users can turn the 4030 into a real-time oscilloscope that displays repetitive signals—a useful feature for engineers who need to view such minor fluctuations as amplitude modulations in a stable frequency. The instrument's dual-channel simultaneous recording ensures that no time resolution is lost when users study two operations.

Available now, the 24-lb 4040 costs less than $4,000.

Gould Inc., Design & Test Systems Division, 4600 Old Ironsides Dr., Santa Clara, Calif., 95050. Phone (408) 988-6800 [Circle 353]

Enhanced in-circuit tester has more pins, redundancy check

The series 30/333E in-circuit test system, an enhanced version of the 30/333 series, offers a larger high-speed test-pin capacity and deeper pin memory than the earlier version, plus a cyclic redundancy check for its high-speed testing mode. The product is designed for manufacturers of complex boards that contain very large-scale integrated and LSI components.



The 333E has 256 real and 512 virtual pins that operate at speeds up to 3.3 MHz while maintaining high-speed testing capabilities. Its enhanced pin memory—4 K by 5 bits—extends the linear test-pattern depth of its high-speed mode, allowing circuits such as gate arrays to be tested.

To be available in the third quarter of 1984, the series 30/333E will cost $175,000 and up.

Fairchild Manufacturing Test Systems, 299 Old Niskayuna Rd., Latham, N. Y. 12110. Phone (518) 783-3600 [Circle 355]

Troubleshooter simplifies fixes during production phase

With the ET-2000 Microtroubleshooter, designed for production testing or portable use, any technician can repair 80% of microprocessor-based board faults and failures, says the company.

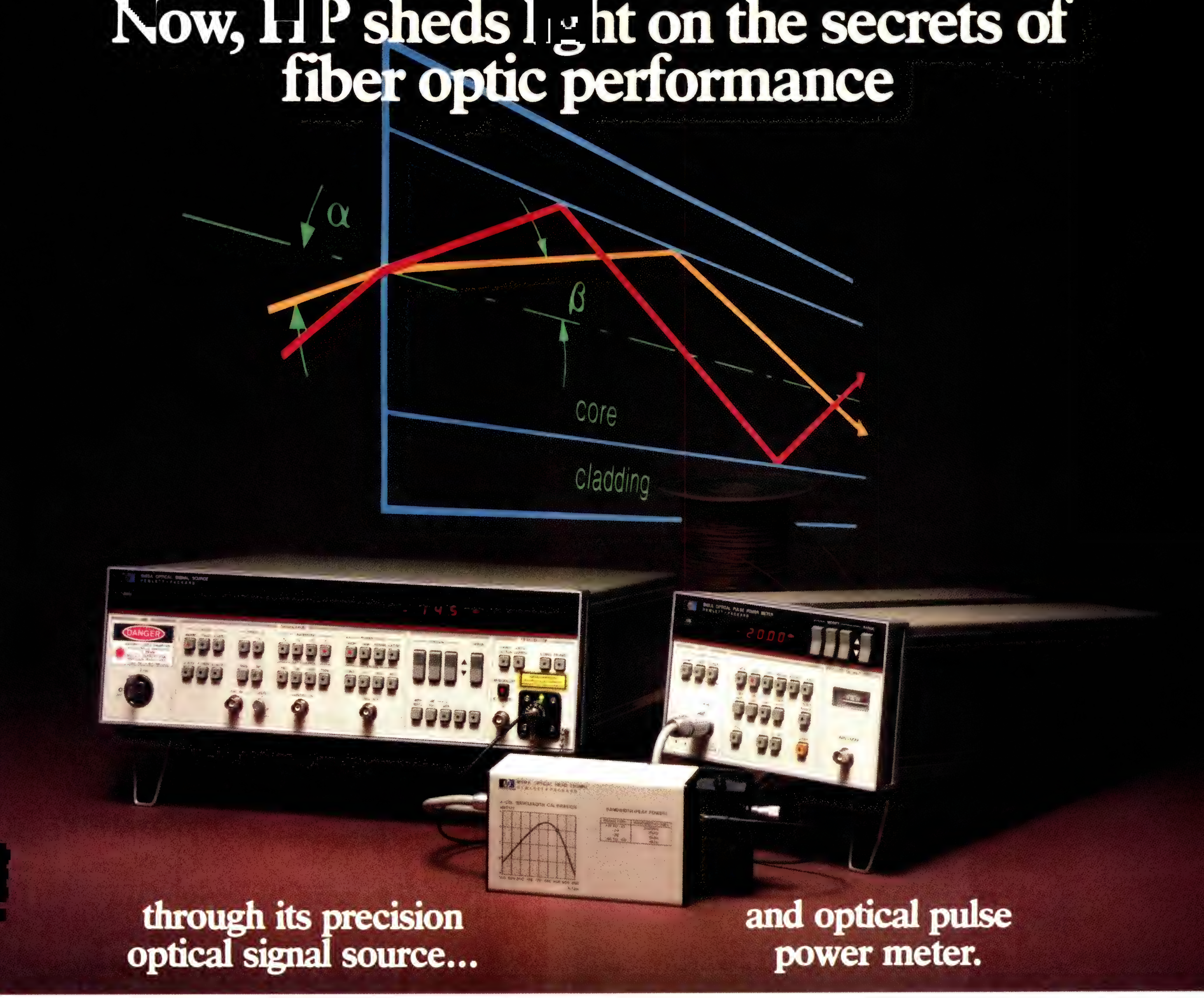
The system's signal identification capability helps technicians sense signals with a special probe, and its 2-line-by-40-character liquid-crystal display shows the signals and the probe's location. For troubleshooting boards beyond the input/output section at 25 MHz, the ET-2000 offers signature analysis, which is useful for faster peripherals.

Intended for use on 8- and 16-bit microprocessors, the ET-2000 has an optional voice package that audibly describes signals and locations.

Priced at under $4,000, the company will start delivering the ET-2000 in May.

Applied Microsystems Corp., 5020 148th Ave. N. E., Redmond, Wash. 98073. Phone (206) 882-2000 [Circle 356]

Now, HP sheds light on the secrets of fiber optic performance



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The result is greater productivity and reliability when designing or troubleshooting fiber optic devices and systems in computer or Local Area Networks, industrial electronics, short-distance telecommunication systems, or aerospace.

A fiber optic pulse/function generator. The HP 8150A, priced at $12,900*, gives you precise control over an 850 nm laser diode's output. Its 250 MHz linear transducer, with programmable gain, provides calibrated outputs from 1 nW to 2 mW. And a built-in 50 MHz pulse function modulator lets you simulate real-world optical signals for functional tests and realistic parametric characterization...all under HP-IB control.

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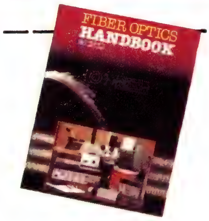
For all the facts on the first in a series of new HP instruments, call your local HP sales office listed in the telephone directory white pages. Ask for the electronic instruments department. Or, send for a copy of HP's 146-page Fiber Optics Handbook. Use the coupon or write to Hewlett-Packard: USA: 1820 Embarcadero Road, Palo Alto, CA 94303. Europe: P.O. Box 529, 1180 AM Amstelveen, the Netherlands. Japan: Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3 chome, Suginami-ku, Tokyo, 168.

* U.S.A. list price only.



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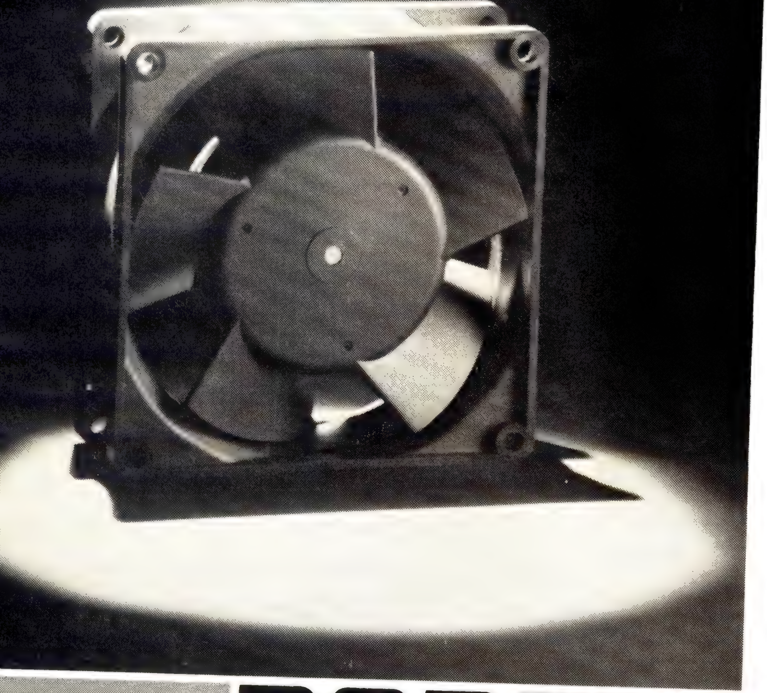

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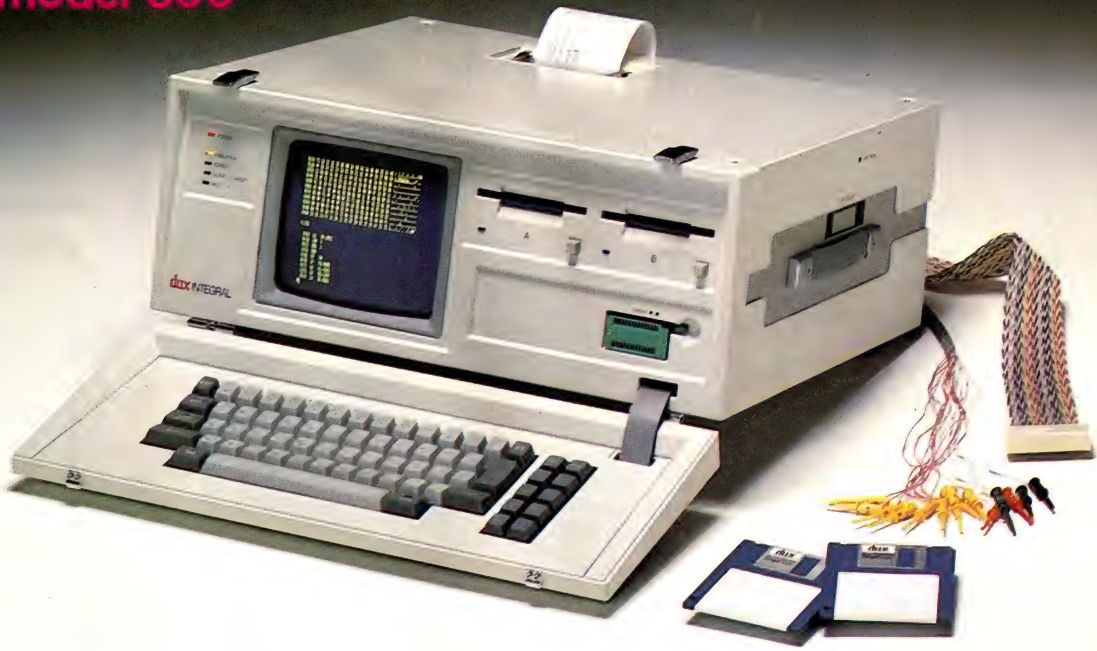

INTEGRAL 800 is a complete package for software development, built around a Z80B, 6MHz CPU with 64KB RAM and using the CP/M™ operating system. Incorporating keyboard, twin 3.5″ floppy disk drive, in-circuit emulator, display screen, PROM programmer and eraser, printer and multiple connection ports into a carrying case the size of a large briefcase, the INTEGRAL 800 is truly profitable for emulation, logic analysis and debugging that requires real-time and hardware tracing. Also, 8 inch floppy disk drives can be connected an option.

There's no short cut to good software, but the dux INTEGRAL makes the job a whole lot easier.

Brief specifications:

CPU:	Z80B, 6MHz
Disk drives:	Twin 3.5″ micro floppies, each with 720 KB storage
Display:	7″ non-glare, amber CRT with 24 lines of 80 characters each
Keyboard:	ASC11 plan with function keys
Printer:	40 columns on thermal paper
PROM programmer	Supports 2716, 2732, 2732A, 2764, 27128 and 27256 with read, write and verify functions
PROM eraser:	UV with 10 min. timer
Target CPU:	Z80, Z80A, Z80B and C-MOS with clock up to 6MHz
Dimensions:	19.3(W) x 6.7(H) x 15.0(D) in 490(W) x 170(H) x 380(D) mm
Weight:	33 lb (15 kg)
Power requirements	AC 115/230V, 50/60 Hz

(INTEGRAL-series) Model—850 (i8085), Model—860 (i8086)

DICE-Z80B IN-CIRCUIT EMULATOR

(DICE-series)
DICE-8085 DICE-8086
DICE-8048
DICE-6502(65C02 is also available)
DICE-6809 DICE-68K

anufacturer

dux KOKUSAI DATA MACHINESYSTEMS INC.
45-6, Iguchi, Mitaka, Tokyo, 181, Japan
Tel: 0422-31-4111 Fax: 0422-31-2050

uthorized export division

NPS INC.
SHIBUYA RESIDENCIAL OFFICE 37-10 UDAGAWA-CHO
SHIBUYA-KU TOKYO 150 JAPAN TEL:(03)466-5400
TELEX: J27832 NPSJAPAN FAX:(03)466-5522

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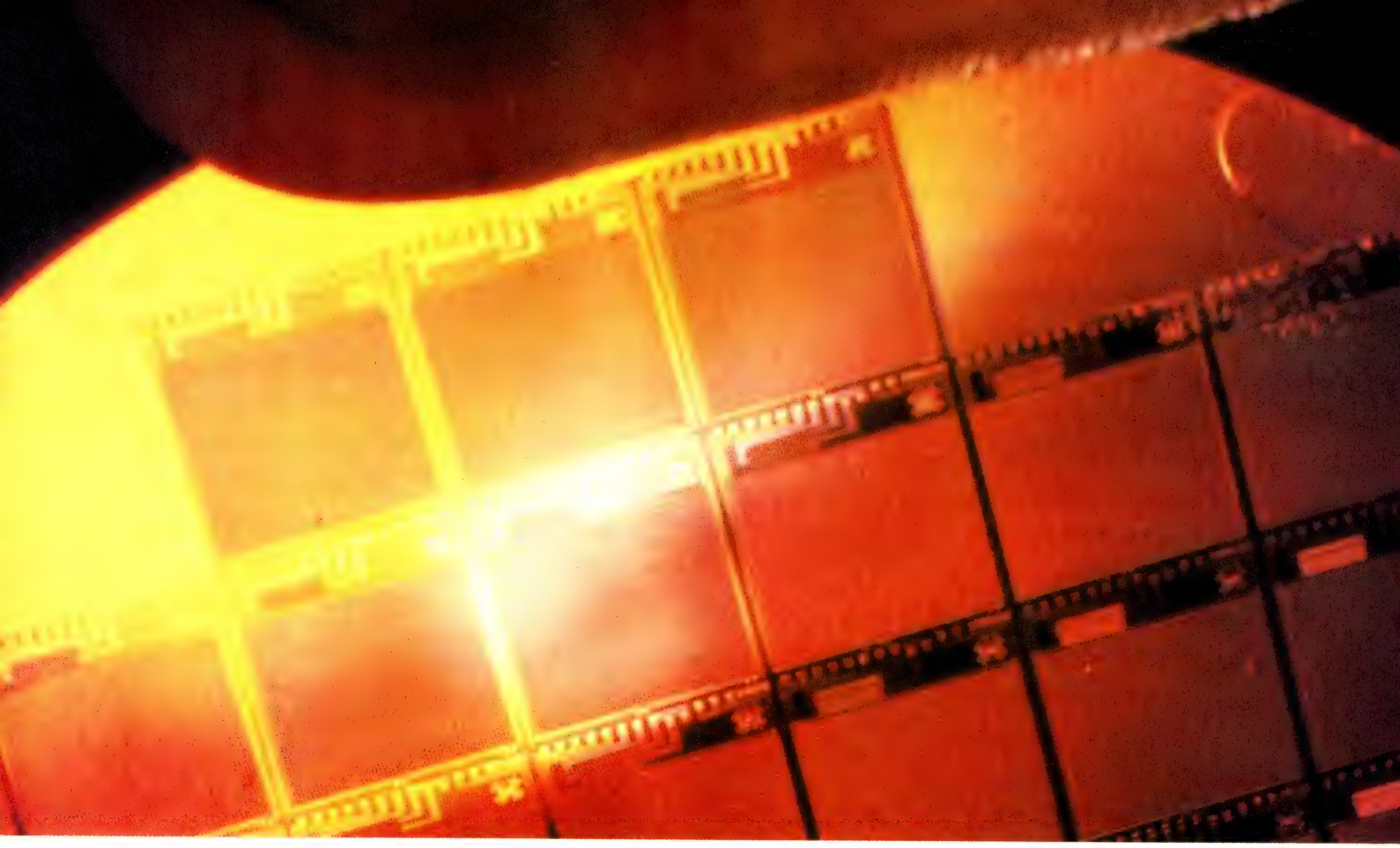

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Source: Crossley Surveys, Inc.

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JULY 28, 1982

SUPERCOMPUTER MAKERS FACE SUPERCOMPETITION/75

Powering a personal computer with the PDP-11 CPU/99

Changed chip architecture processes signals at record speed/105

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Electronics

SPECIAL REPORT

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Software

Integrator keeps nine windows open at once

Shown for the first time at last year's spring Comdex, a multiple-window software integrator that combines such functions as word processing, a spreadsheet, and data-base management is finally becoming available, at a price of $399. The software, called DESQ, can be used with many personal computers, including the International Business Machines Corp. Personal Computer, and supports most off-the-shelf MS-DOS and PC-DOS software without modification.

Users can show DESQ how to handle a routine task by performing it once and assigning keystrokes. They can also create in-system help menus and show DESQ how to transfer data, plus how to create, edit, and save programs or custom menus.

Up to nine windows can be open at any one time, and the user can change their colors, sizes, and locations. The software runs on systems configured with 256-K bytes of random-access memory, as well as 5¼-in. floppy-disk drives and 5-megabyte Winchester hard disks.

Quarterdeck Software, 1918 Main St., Suite 240, Santa Monica, Calif. Phone (213) 392-9851 [Circle reader service number 361]

Multiprocessor units run three operating systems

The MS-DOS operating system has been added to Molecular Computer's CP/M-compatible multiuser, multiprocessor computer systems, giving users concurrent access to CP/M, MP/M, and MS-DOS applications. In addition, thanks to the computer's multiprocessor architecture, as many as 64 users can access either 8- or 16-bit microprocessors.

The company's MS-DOS implementation operates together with its proprietary n/Star network operating system, which uses the standard CP/M file structure on the system's hard-disk drives. The transfer of data between CP/M and MS-DOS files, and to and from applications, has been made possible by a utility for import and export of data.

Available immediately, the software is priced at $300.

Molecular Computer, 251 River Oaks Pkwy., San Jose, Calif., 95134-1986. Phone (408) 262-2122 [Circle 365]

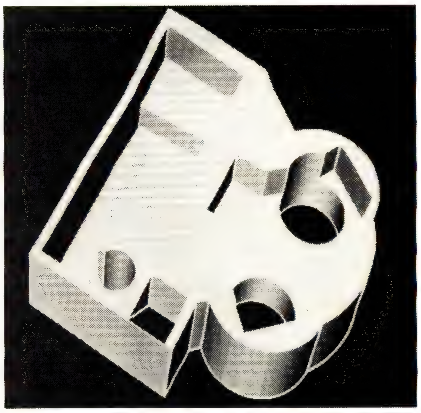
Operating-system software will not violate IBM's copyright

Manufacturers of computers compatible with International Business Machine Corp.'s Personal Computer have been searching for read-only-memory BIOS software that will make their machines totally compatible without infringing IBM's copyright. Phoenix Software Associates Ltd. is now offering a solution.

Phoenix has introduced for licensing original PC-DOS-compatible software, developed under strict controls to avoid copyright infringement. By choosing Phoenix BIOS, manufacturers can avoid an in-house development effort and still have a BIOS designed not to infringe IBM. The BIOS is available as part of a software package to make machines fully compatible with PC-DOS. An unlimited-use license costs $290,000. What's more, the company is also offering copyright insurance.

Phoenix Software Associates Ltd., 1420 Providence Hwy., Suite 260, Norwood, Mass. 02062. Phone (617) 769-7020 [Circle 362]

CAD software with data base runs on 32-bit processors



Designed for 32-bit processors, an interactive graphics software package with an associative data base called Unigraphics II can be used in several phases of product development, including engineering design and analysis, drafting, and the generation of numerical-control data for manufacturing. The easy-to-use tool runs on several superminicomputers under a number of operating systems.

Its associative data base lets users create and manipulate links in pieces of data to help automate design, drafting, and manufacturing. Among the functions automated are the dimensioning of drawings and the development of programs to help machine complex product geometries.

To be available in July, the tool is priced at $40,000 for use on small systems and $60,000 on large ones.

McDonnell Douglas Automation Co., St. Louis, Mo. 63166. Phone (314) 232-5911 [Circle 367]

Link works with all IBM PCs using DIF or CSV file formats

With a dictionary-driven software-transfer program called iLink, users can download, upload, or crossload

How many sources does it take to design, build, and test an effective clean room?

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One.

The design and construction of a clean room to meet the demanding needs of electronics production is a complicated and costly task. All too often the complexities of coordinating separate designers, process consultants, various contractors, component suppliers, and certification services results in devastating time delays, cost overages, and, in most cases, an ineffective clean room.

The answer to this problem is to find one company with the total capability to take a clean room from start to finish, with guaranteed results, on time and on budget.

That one company is Comp-Aire Systems.

As the industry's leader in the manufacture of the most advanced clean room systems and components, Comp-Aire has the state-of-the-art expertise to analyze and understand user requirements and tailor a clean room facility to exact needs.

Comp-Aire's engineering team, the CAS Engineering group, works closely with every customer to provide a detailed analysis of exact clean room needs, complete with process drawings and recommended high technology equipment and processes needed to meet production goals. All phases of clean room construction are carefully controlled to insure adherence to schedules, budgets, and specifications. Each facility is thoroughly tested and balanced upon completion.

Comp-Aire is devoted to delivering the highest reliability components and systems for class 1,000, 100, and 10 environments, but particle management is only the beginning when it comes to building effective clean rooms. For more information on how Comp-Aire can be the best single source to meet your clean room needs, contact your nearest Comp-Aire representative; call, or write Comp-Aire Systems, Grand Rapids, Michigan.

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Systems, Inc. 4160 44th SE
Grand Rapids, MI 49508
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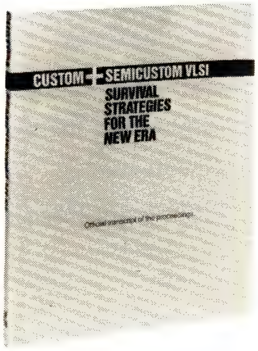
CUSTOM AND SEMICUSTOM VLSI:
Survival Strategies
For The New Era



The semiconductor industry is changing. Are you equipped to meet the challenges of this ever-changing industry? Crucial decisions are at hand. *Electronics* Magazine and Gnostic Concepts Inc. sponsored this prestigious seminar and the transcript is now being made available to those who understand the challenge of these changes.

A panel of industry experts presents up-to-date, significant information that probes major technological concerns such as:

- Company benefits by custom design
- Economical appropriateness for tackling custom
- Evaluation of gate arrays and standard cells
- Alternate processes to explore
- Suitability of CAD systems to your particular company

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data from International Business Machines Corp. Personal Computers to IBM mainframes. The system is compatible with all PC application programs using DIF or CSV file formats for data management, graphics, and financial analysis, including Lotus 1-2-3, VisiCalc, SuperCalc, and dBase II.

The data transformed into mainframe exchange files can be accessed by any product, package, or language running under VM/CMS, including SAS, Ramis, Focus, ADRS, APLDI, and FPS. The iLink package, which also crossloads data between different mainframe data-base products and different software packages, includes such features as an electronic note pad and field-name and -width modification.

Shipments of the product, priced at $12,500, can be made to original-equipment manufacturers now.

InfoCenter Software, 171 Main St., New Paltz, N. Y. 12561. Phone (914) 255-8925 [Circle 364]

Integrated software satisfies both novice and expert users

Three integrated programs written in the C programming language have the versatility and flexibility sought by expert computer users but are simple enough for novices in home environments. PractiWord, a word processor; PractiBase, a relational data-base manager; and PractiCalc III, an electronic spreadsheet, are available separately or as a unit.

Many of the same commands are found in all three programs, so once users have learned one set, they know common functions in the programs sharing the same commands.

For use on the IBM Personal Computer, the software has a menu system geared toward professionals that offers basic commands on using software as well as a help menu. Also provided is a capability allowing the user to insert data from one program into another. The system also allows data from files used by one program to be accessed by another. Available now, the programs are priced at $99.95 each or sold together for $250.

Practicorp International Inc., The Silk Mill, 44 Oak St., Newton Upper Falls, Mass. 02164. Phone (617) 965-9870 [Circle 368]

Inverted file structure makes data-base retrieval easy

The retrieval capabilities formerly found only on commercial data bases operating on mainframe computers can now be achieved using microcomputers. A system called Finder stores and retrieves textual information in large data bases and is geared to researchers, engineers, technical libraries, and information centers. Finder creates inverted files capable of indexing every word or term in a data base—not just a few words assigned by the user.

Available now for use on International Business Machines Corp.'s Personal Computer and PC XT, as well as on Tandy Radio Shack Models II, 12, and 16, the system is priced at $1,495.

Aaron/Smith Associates Inc., Suite 518, 1422 W. Peachtree St. NW, Atlanta, Ga. 30309. Phone (404) 876-0085 [Circle 369]

CAD software tools operate on Daisy, Mentor work stations

Advanced complementary-MOS standard-cell-library and computer-aided-design software tools are now available for the Daisy Systems Corp.'s Logician and for Mentor Graphics Corp.'s Idea work stations.

The VLSI interconnection and timing-analysis software (VITA) includes programs that can calculate circuit-path delays before and after the physical layout. For timing analysis, the verifiers on the work stations make use of the delay information that is derived with VITA.

The tools are available now, and their cost varies with user needs and installation charges.

NCR Microelectronics division, Product Marketing, 2001 Danfield Ct., Fort Collins, Colo. 80525. Phone (303) 226-9500 [Circle 366]

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Applied Microsystems Corporation:
Changing your ideas about emulation.

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3

ALL IN-CIRCUIT EMULATORS NEED A HOST

If you walk into your engineering department and see a group gathered around the development system or computer it's either because they are planning your surprise birthday party, or that they're simply waiting to log-on.

That's why it's so important that in-circuit emulators have the capability to accept software developed on a host system and then function as a stand-alone instrument. This allows you to *disconnect* from the host to debug software and integrate it with hardware, leaving the host system free for other development tasks. Which means better utilization of manpower and computerpower, and more time for birthday parties (or "product released on time" parties).

OUR EMULATORS INVITE MORE USERS.

Because in-circuit emulators from Applied Microsystems have stand-alone capabilities they can be used for more than just new product development.

Hand one over to the manufacturing test department and see how delighted those engineers are to find out they can use existing test routines.

Or if you're jumping from one type of microprocessor-based project to another you won't have to learn an entirely new system. We offer real-time emulation capability for Intel, Motorola, National and Zilog 8-bit and 16-bit microprocessor families.

It makes more sense to add another emulator when you add more staff to your department, rather than another computer workstation or MDS.

DON'T KEEP YOUR ENGINEERS WAITING.

Free-up your traditional development tools by taking advantage of stand-alone in-circuit emulation from Applied Microsystems Corporation. Contact us at:

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8032 Gräfelfing
West Germany
c/o Steve Thatcher
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Stand alone
in-circuit emulation
for 8-bit and 16-bit microprocessors

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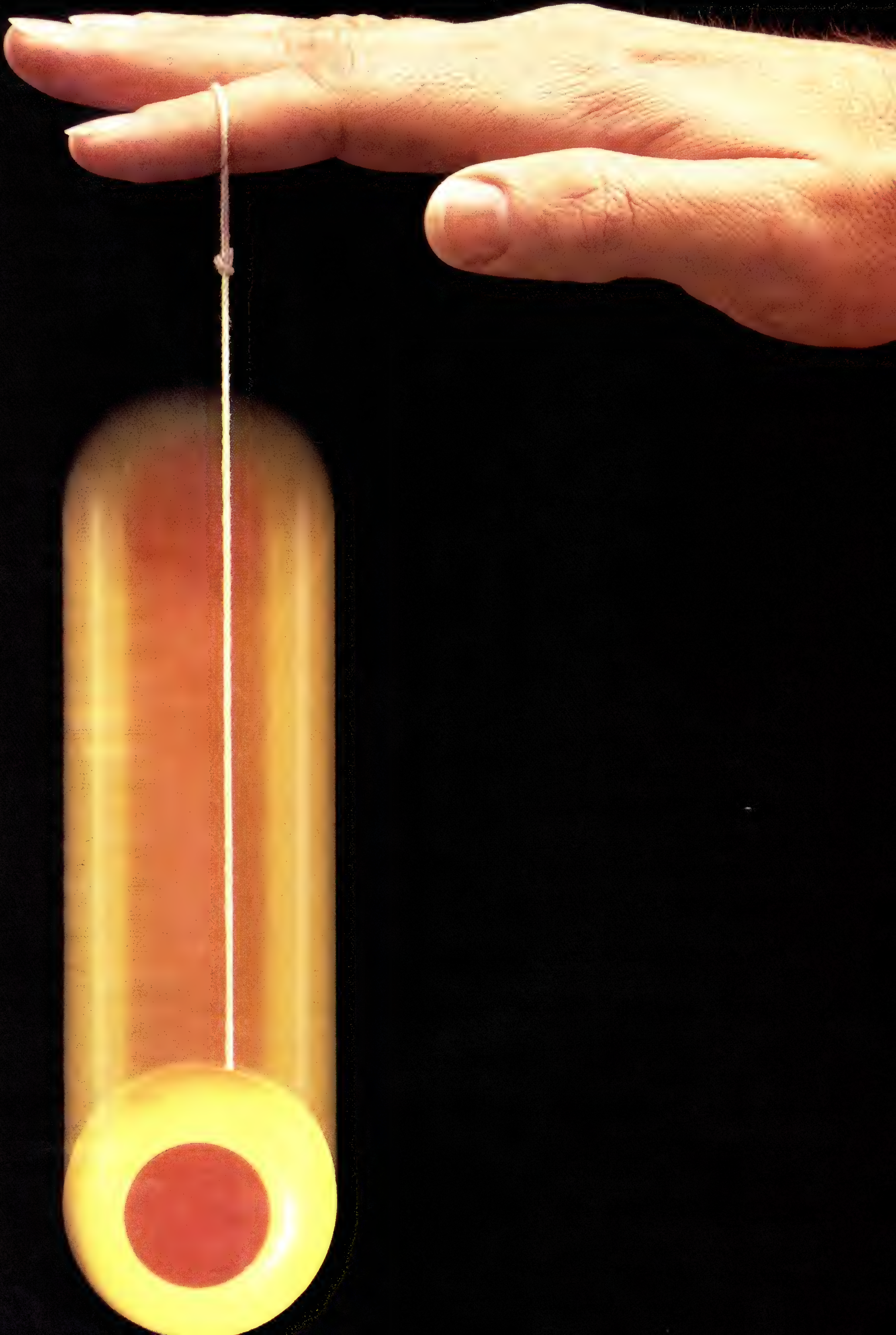
he ups and downs of the Power business



...the growth factors

You know the companies in the power business that appear to be going downhill, and others that cannot compete worldwide. Some seem to lack corporate policy. Others have a poor product range or are weak in major applications.

But constant and aggressive growth is the description that best fits SGS. Our technology is second to none; our increasing number of plants are the most modern, and our product range is growing fast – fastest in the industry.

1 Over 1000 standard types, covering almost every application, and growing by not less than 1 new type every day.

2 Many innovative products including High Voltage up to 1500V, Power MOS types and high power modules up to 35kVA.

3 Seven volume packages – TO-126, SOT-82, TO-220, SOT-93, TO-39, TO-3 and TO-240.

4 5″ wafer capability, ion implantation and other state-of-the-art technologies.

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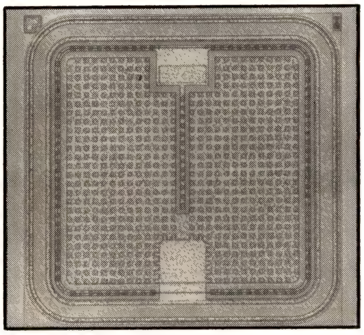
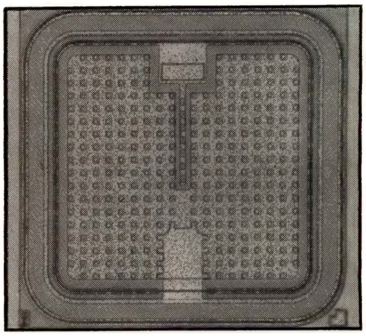
Facts about state-of-the-art Power MOS from SGS

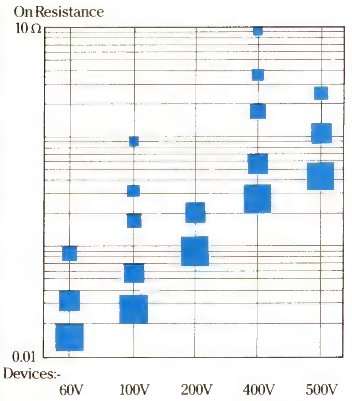
Optimised Power MOS geometries for different voltage ratings combined with proven Power technology make SGS Power MOS transistors the obvious choice to optimise your very high speed switching applications.



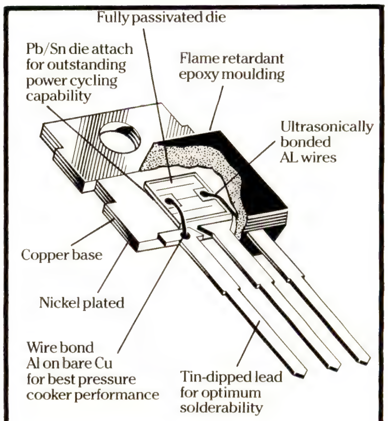
Channel resistance is the limiting factor:
SGS geometry optimised with small cells and minimum spacing.



Drain epitaxial resistance is the limiting factor:
SGS geometry optimised with larger cells and wider spacing.



5 die sizes, 5 voltage ranges and 5 package types give a total product range of over 100 standard devices.


Fully passivated die
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Copper base
Nickel plated
Wire bond Al on bare Cu for best pressure cooker performance
Tin-dipped lead for optimum solderability

Power MOS.

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Like every SGS Power device, all MOS transistors are available from our worldwide sales organisation. So why not prove these facts for yourself? And gain from our world leadership in power technology.

Communications

Office system is fashioned for small firms

An integrated office-telecommunications and -information service called Telenova 1 is designed to serve from 10 to 100 small-business users. The system, which is based on a single module that carries voice and data over standard two-pair telephone lines, provides a digital-telephone system, local-network capabilities, and information services.

Users of Telenova 1 can configure networks to their needs. For example, data resources—such as printers and modems—can be connected to the Telenova module and shared by all stations on the network. When personal computers and data terminals are connected through RS-232-C ports into a desktop Telenova station set, the system can display information from outside data sources.

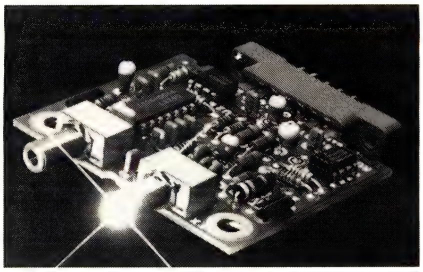
A two-line 40-character display guides the user through each step and highlights only functions that are useful at a given time. For fully configured systems with 100 phones and 20 outside lines, Telenova 1 is priced at $800 per port and is available now for immediate delivery.

Telenova Inc., 102-B Cooper Ct., Los Gatos, Calif. 95030. Phone (408) 395-2260 [Circle reader service number 401]

Transceivers provide a link that performs at 20 megabaud

A series of fiber-optic transceivers containing HFBR-1201 and -1202 transmitters and HFBR-2203 and -2204 receivers supports circuitry to provide TTL inputs and complementary-TTL outputs. The transceivers sport combinations of Hewlett-Packard or subminiature type-A connector styles and Manchester and biphase or nonreturn-to-zero and return-to-zero inverted code schemes.

At 20 megabaud, the transceivers' operating temperatures extend from 0° to 70°C. The line provides a TTL input/output link to low-volume users. Those with high volumes can use the transceivers as a design aid and prototyping tool to create low-priced links that incorporate HFBR-1201 and -1202 transmitters and HFBR-2203 and -2204 receivers.



The transceivers, which are available right now, sell for $175 apiece in quantities of 250.

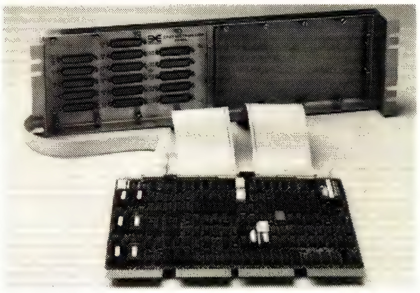
Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 402]

16-line multiplexers work with LSI-11s, PDP-11s

The CS02/HA communications multiplexer, designed for Digital Equipment Corp.'s LSI-11/23 and LSI-11/23 Plus central processing units, comprises the company's CC02 communications controller and the CP22/B 16-line distribution panel, which uses 25-pin connectors.

The CS02/HB, a second multiplexer, is designed for the Micro/PDP-11 CPU and comprises the CC02 controller and the compact CP24 16-line distribution panel, which uses nine-pin connectors with RS-423-interface capability.

The CC02 controllers are quad-size, four-layer printed-circuit boards featuring a high-speed, bipolar microprocessor architecture able to support 16 terminals. Data can be transmitted and received simultaneously at up to 38.4 kilobaud on each of the 16 lines.



Both the CS02/HA and the CS02/HB are priced at $2,300 and can be delivered in 30 days.

Emulex Corp., 3545 Harbor Blvd., P. O. Box 6725, Costa Mesa, Calif. 92626. Phone (800) 854-7112 [Circle 406]

Interface card lets Apple IIs talk to IBM mainframes

An interface card transforms Apple II personal computers into multifunction desktop computers with access to a wide range of mainframes. When equipped with the Communications Protocol Card, Apple II computers can act as remote terminals or work stations on International Business Machines Corp.'s networks and can communicate with many mainframes, such as the IBM 360, 370, 4300, and 303X.

The card makes it possible to use the Apple II for such tasks as on-line data entry, electronic mail, and re-

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AUTOMATIC LCR METER

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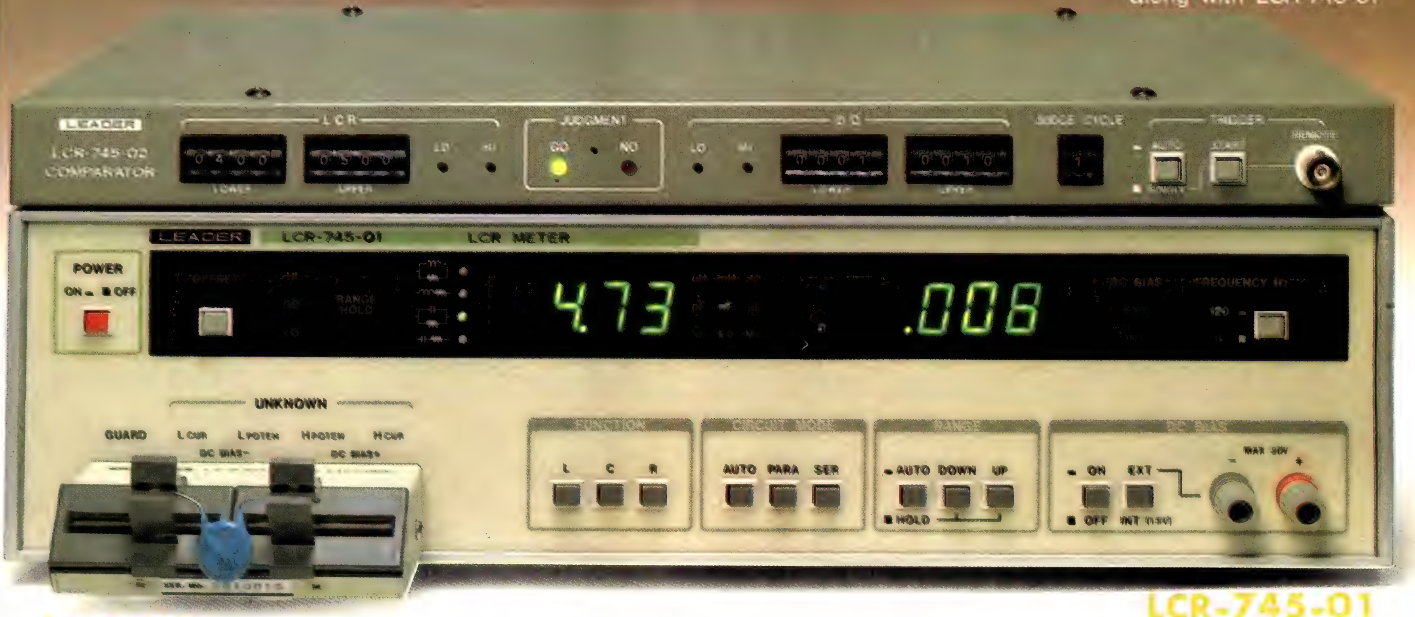
(with BCD Output) (Comparator)

LCR-745-02
Digital Comparator used
along with LCR-745-01



LCR-745-01
LCR Meter completed
with BCD Data output

LF-2351
Inserting Type Test Fixture

LF-2350
Kelvin's Clip Type Test Fixture

- New Comparator unit LCR-745-02 is newly available for instant GO-NO judgement of L.C.R.D.Q, if it is used alongwith LCR-745-01, LCR meter completed with BCD data output.
- GO-NO judgement is made by LED and/or buzzer if upper and lower limits set by thumb wheel switch.
- As optional accessories, test fixture LF-2350 is now available for remote test and LF-2351 for one touch test.

LCR-745-01 SPECIFICATIONS

- Measuring Items : L,C,R,Q,D
- Test Frequency : 1kHz & 120Hz
- Measuring Range
  - ①L : 0.1μH–199.9H
  - Q : 0.5–99.9
  - ②C : 0.1pF–1999μF
  - D : 0.001–1.999
  - ③R : 0.001Ω–19.99MΩ

LCR-745-02 SPECIFICATIONS

- Judge Item : L,C,R,Q,D.
- Preset Range : Ordinary measurement ; 0000–1999 (upper>lower), Deviation Measurement ; plus side 0000–1999, minus side 0000–1999
- Judge Display : Total Judgment ; GO–NO LED and electronic buzzer, LCR ; HI-LO, QD ; HI-LO
- Judge Delay : Judge cycle ; 1–9

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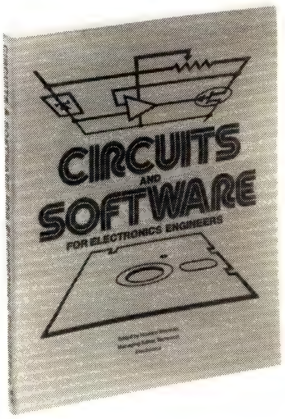

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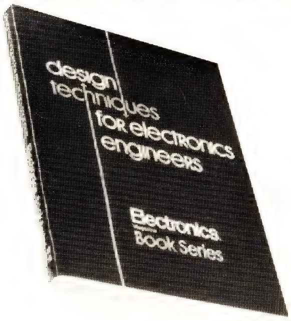

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mote data-base access, as well as for word processing, financial modeling, and business graphics. Its use requires one of two Apple software packages: the 2780/3780 Emulator program controls the card when an Apple II is used for remote job-entry applications; the 3270 Emulator makes the Apple II interactive.

The card, priced at $700, and the software packages, at $300 each, are available now.

Apple Computer Inc., 20525 Mariani Ave., Cupertino, Calif. 95014. Phone (408) 996-1010 [Circle 403]

Line of modems operates from 1,200 to 9,600 bits/s

The DF100 line of modems features operating speeds of 1,200 to 9,600 bits/s, integrated automatic calling, and RS-232-C and RS-423-A interfaces. The modems can be used in applications ranging from remote dial-in time-sharing to network connections.

The five modems in the line, all available in rack-mounted or stand-alone versions, use identical circuit cards, letting designers and systems managers maintain a minimum amount of spare parts.

The modems are priced from $545 for the rack-mounted 400-b/s DF104 modem to $3,045 for a stand-alone DF129 9,600 b/s leased-line modem. They are available now.

Digital Equipment Corp., 129 Parker St., Maynard, Mass. 01754 [Circle 404]

Units' controllers address up to 32 subscriber lines

A set of pulse-code-modulated codec/filters plus multichannel controller circuits for digital subscriber-line-card designs comprises the TP3110J and TP3120J digital-line interface controllers and the TP3051/56J parallel codec/filter Combo circuits.

The TP3110J, with two serial time-division-multiplex highways, and the TP3120J, with four TDM se-

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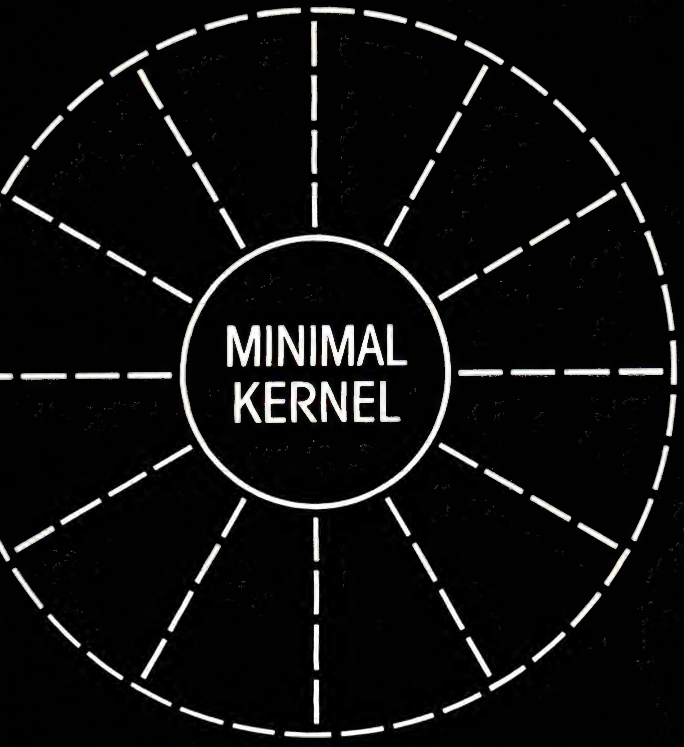
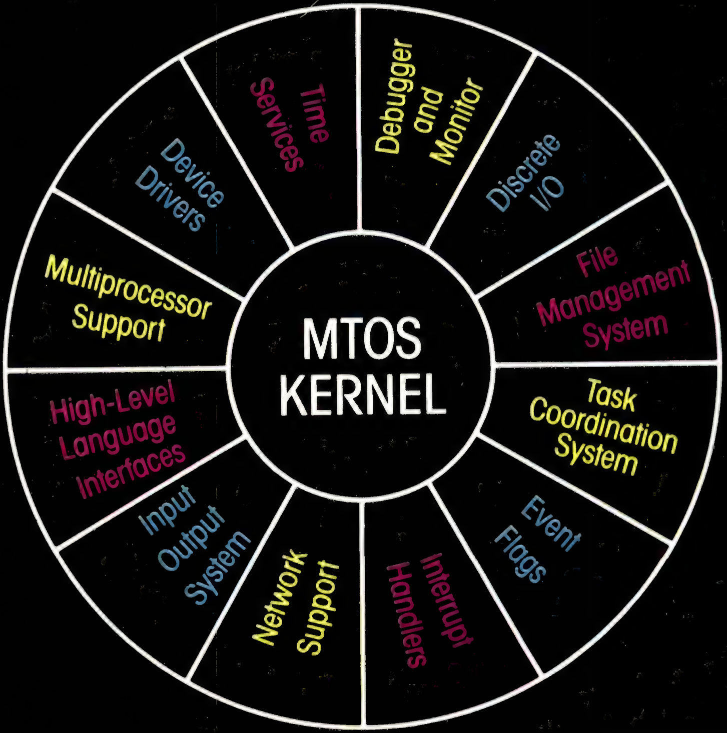


MINIMAL SYSTEM



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For more information on MTOS, the multi-tasking operating system that saves time and money, contact Industrial Programming Inc., 100 Jericho Quadrangle, Jericho, NY 11753. (516) 938-6600 Telex: 429808 (ITT)

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Circle 145 on reader service card

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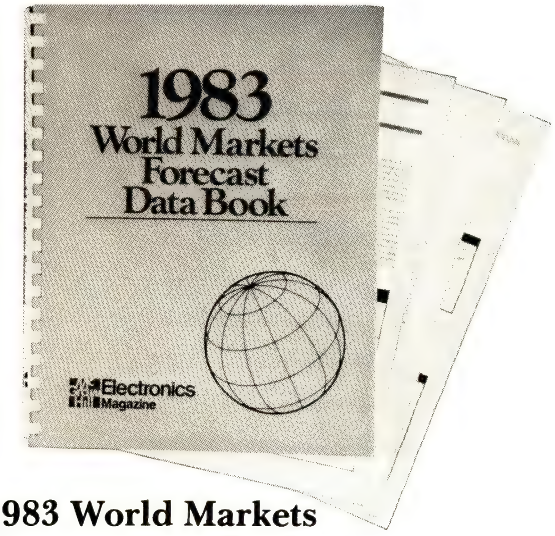

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rial highways, provide high-speed nonblocking switching for integrated voice and data communications. The controllers feature a parallel bus-to-codec structure that enhances line-card performance by addressing up to 32 subscriber lines and performing first-level time and space switching. With a microprocessor, they can convert call-control data into a common format before passing the data to the main system controller.

Production quantities of the TP-3110/20 are available now in 40-pin dual in-line packages. In quantities of 100 to 199, the price for the TP3110J comes to $17.50 each. Pricing on the TP3120J in Cerdip packages will be $18.50 each in quantities of 100 to 199.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051. Phone (408) 721-5402 [Circle 405]

Processor does level-3 routing in under 1 ms per packet

A high-throughput version of the Telepac II intelligent communications processor handles X.25 packets and provides complete level-3 routing in less than 1 ms per packet.

Telepac II is a modular system for simple expansion and integration of statistical multiplexer networks, X.25 networks, and multiple-host computers. It can process packet sizes of up to 256 bytes at a continuous peak-departure rate of 1,000 packets/s. Additional X.25 direct-memory-access ports and memory can be added to a basic Telepac II, and one Telepac processor can simultaneously control 1,000 virtual circuits.

With Telepac, up to 1,000 terminals per node can be dynamically routed with user-defined routing, including host-port contention and resource queuing. Comprehensive flow-control options and network diagnostics are featured.

Prices start at $17,000 for a Telepac II processor with full X.25 level-3 software. Delivery takes 60 days.

Telefile Computer Products Inc., 17131 Daimler St., Irvine, Calif. 92714. Phone (714) 557-6660 [Circle 407]

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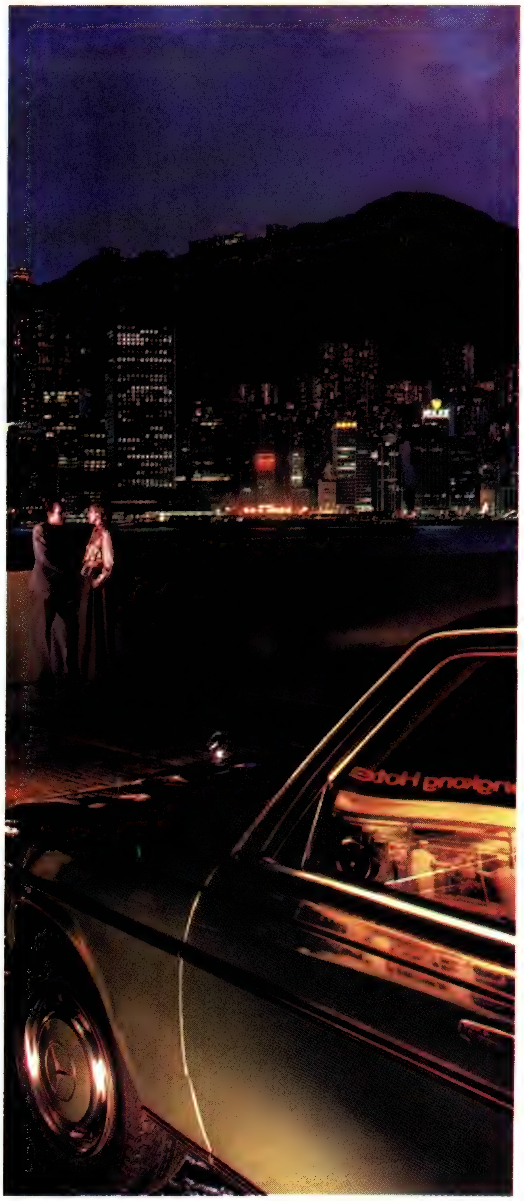

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Circle 189 on reader service card

FOCUS ON CHANGING TECHNOLOGY AND ITS OPPORTUNITIES!

Sellers of high-resolution graphics tubes/monitors, display processors, graphics subsystems, engineering workstations and personal computers will meet their buyers in Electronics' Special Report: Computer Graphics.

June 28 Issue
Closes June 4

Higher resolution monitors and corresponding display systems, faster raster display circuits which eliminate flicker and new, more powerful 32-bit graphics processors are changing the state-of-the-art of computer graphics hardware technology. The Special Report: Computer Graphics, prepared by Electronics' Information Systems Technology Department, reviews this technology, its CAD/CAM/CAE applications, reports on the computer graphics standardization and looks at the role of graphics in the latest personal computers.

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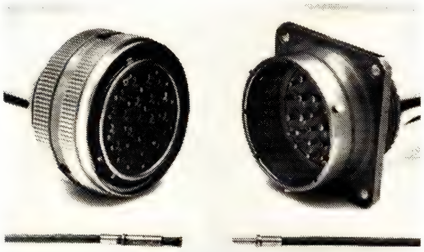
Circle 191 on reader service card

Packaging and production

Light connector contacts boast little EMI

ITT's Cannon division has designed fiber-optic-connector contacts that can replace 16-pin and -socket electrical contacts in aircraft and military communications systems that demand lower weight, size, and levels of electromagnetic interference, in addition to fast data-transmission rates. The contacts are designed to fit into size-16 cavities without requiring modification to connectors.



Moisture-sealed so that electrical contacts can be used in the same connector, the devices feature a glass-fiber jewel alignment that provides precise centering. The contacts are currently available for use with MIL-C-38999 I and III and Arinc 600 connectors; other versions are being developed for MIL-C-83273 connectors. Priced at $20 a mated pair in lots of 100, the contacts can be delivered within six weeks.

ITT Cannon Division, 10550 Talbert Ave., P. O. Box 8040, Fountain Valley, Calif. 92708. Phone (714) 964-7400 [Circle reader service number 391]

System uses two waves for soldering chip-carriers

Designed to solder the contact pads of components in leadless chip-carriers to the conductive pads of printed-circuit boards, a dual-pump wave-soldering system utilizes two different solder waves that are produced by a single-nozzle combination.

The first, a narrow, turbulent wave, ensures that the solder is forced into the chip array and that it reaches all attachment points. It also provides enough pressure to overcome the repelling and hydrodynamic turbulence caused by the component bodies and therefore ensures that all pads have been wetted with solder. The second wave embodies the characteristics of the Lambda wave with zero-defect capabilities and is the key to high-quality solder-fillet formation.

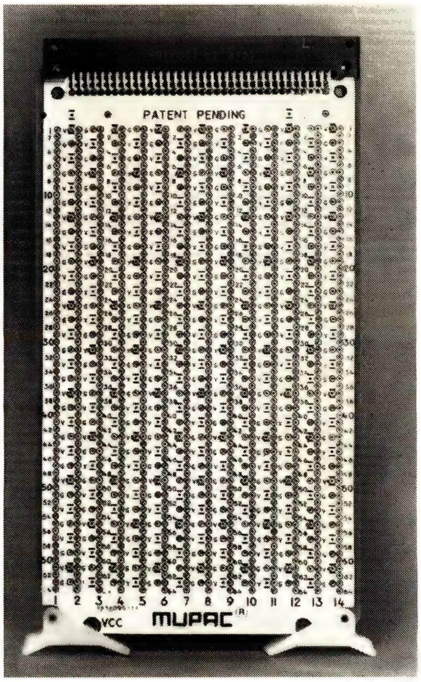
The depths of the two waves can be adjusted independently, a feature that makes it possible to select solder contacts and vary the conveyor incline in the best possible way.

Available 18 weeks from date of order, the system costs from $50,000 to $60,000.

Electrovert USA Corp., Suite 101, 10969 Shady Trail, Dallas, Texas 75220. Phone (214) 353-9950 [Circle 392]

Wire-wrapping panel handles fast rise and fall times

The 323 high-speed wire-wrapping panel minimizes the effects of system noise, crosstalk, ringing, and propagational delay as well as handles the fast rise and fall times associated with Schottky drives. The 4.5-in. panel features four-layer construction, continuous socket terminal rows on 0.300-in. centers, dedicated supply-voltage and ground-connector pins, and a two-piece 108-pin connector for maximum input/output capability. Because copper foil has been wrapped around each pin on all layers, any pin can be selectively committed to the supply voltage or ground planes.



Priced at $183.90 in small quantities, the panel will be available next month.

Mupac Corp., 10 Mupac Dr., Brockton, Mass. 02401. Phone (800) 225-0398 (in Mass., 617-588-6110) [Circle 394]

Linear-measurement unit attaches to microscope stages

Developed to bring the convenience of digital measuring and recording to users of small microscope stages, a miniature linear-measurement system does not interfere with slide specimens in the work area and can easily be retrofitted to stages by plant technicians.

Using the model LM, comprising a miniature scale connected to a digital readout, technicians can measure and digitally display specimens that are up to 6 in. long with a resolution of ±0.0002 in. The display is available with either metric or English and metric readouts.

A single-axis version with the metric readout sells for $995; delivery takes about three weeks.

Boeckeler Instruments, 31 E. Rillito St., Tucson, Ariz. 85705. Phone (602) 622-2197 [Circle 395]

System repairs circuitry on multilayer pc boards

The circuitry on multilayer printed-circuit boards measuring up to 18 by 18 in. can be reworked or repaired with a system consisting of an X-Y coordinate table with a drillhead,

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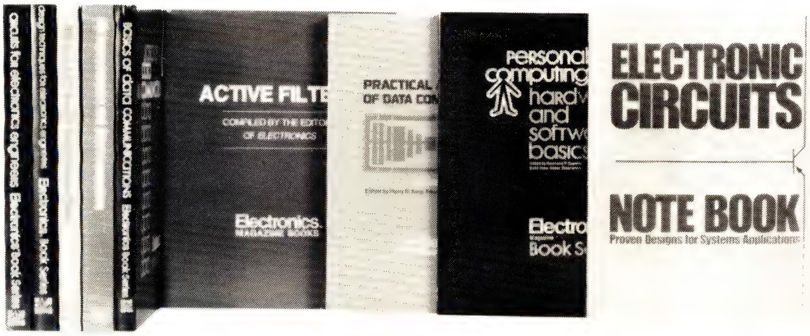

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This compilation of essential articles from *Data Communications* magazine includes chapters on terminals, acoustic couplers and modems, communications processors, networking, channel performance, data link controls, network diagnostics, interfaces, and regulations and policy. Pub. 1976, 303 pages, softcover.
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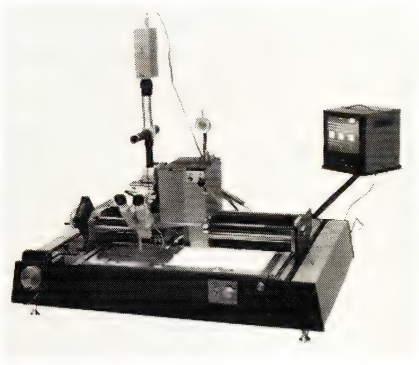

viewing optics, and a depth-control mechanism that is accurate to within 0.001 in.

When a slight pressure is applied to the Multi-Layer Rework System's drillhead-lowering lever, a pneumatic cylinder engages and swings the drillhead into the optical-drill centerline. More pressure lowers the head until it engages a positive stop just before the drill point enters the work. The optics system enables operators to see the drilled-out hole and to watch a magnified version of the work in progress on a closed-circuit TV.

The Multi-Layer Rework System is priced at $17,000; delivery takes up to eight weeks.

Ambrit Inc., Andover St., Wilmington, Mass. 01887. Phone (617) 658-2291 [Circle 393]

Burn-in board system unloads 26,000 boards in one hour

Requiring only 12 ft^2 of floor space, the 20K-MPX Burn-in Board unloads extra-wide boards in 50 s with throughput rates of 26,000 units/h. The fully automatic microprocessor-controlled system unloads boards with a single pass or in two passes with automatic side shift.

Thanks to its interchangeable board carrier, the 20K-MPX can handle most board styles in a single dual in-line package. To ensure 100% lead quality, the unit removes the DIPs straight from the socket, eliminating wedging problems.

Priced at $21,550, the 20K-MPX is available now.

Idea Inc., 3000 Scott Blvd., Suite 111, Santa Clara, Calif. 95050. Phone (408) 727-5281 [Circle 398]

Take the next step now! Convert your dial-up datacomm system to 9600 bps

Traffic growth is inevitable for a successful datacomm system. Why not get ready for it?

With UDS' 9600 A/B modem, you can have the benefits of 9600 bps right now, using your present dial-up equipment. Then, if a change to dedicated lines becomes attractive, you'll have all the hardware you need. A few simple strap changes, and you'll be ready for dedicated line operation.

In the meantime, you'll be enjoying the inherent economies of 9600 bps communication over the dial-up network. The next step is cost effective — quantity one price for a UDS 9600 A/B is only $2650.

For detailed specifications, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, Alabama 35805. Telephone 205/837-8100; TWX 810-726-2100.

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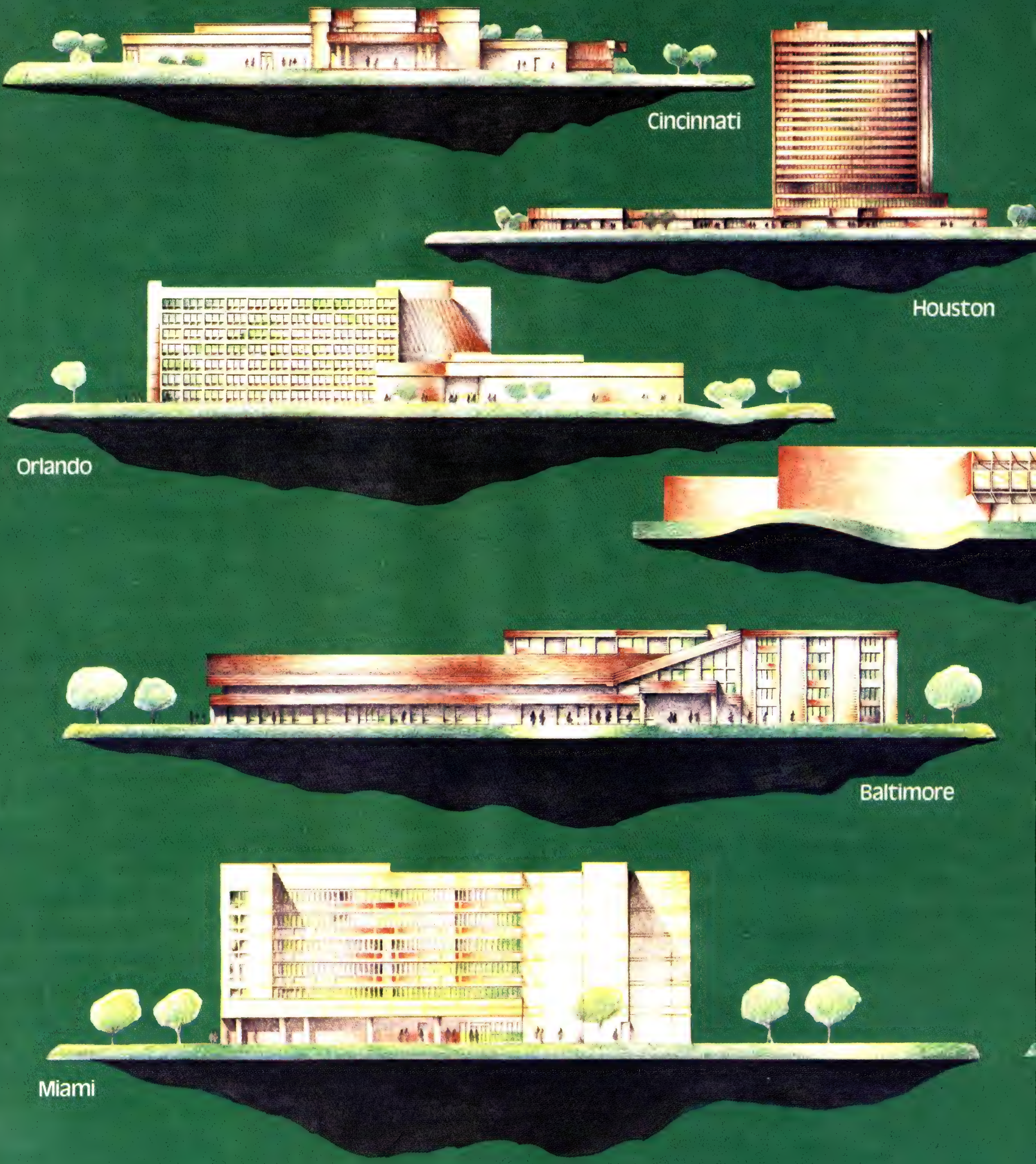

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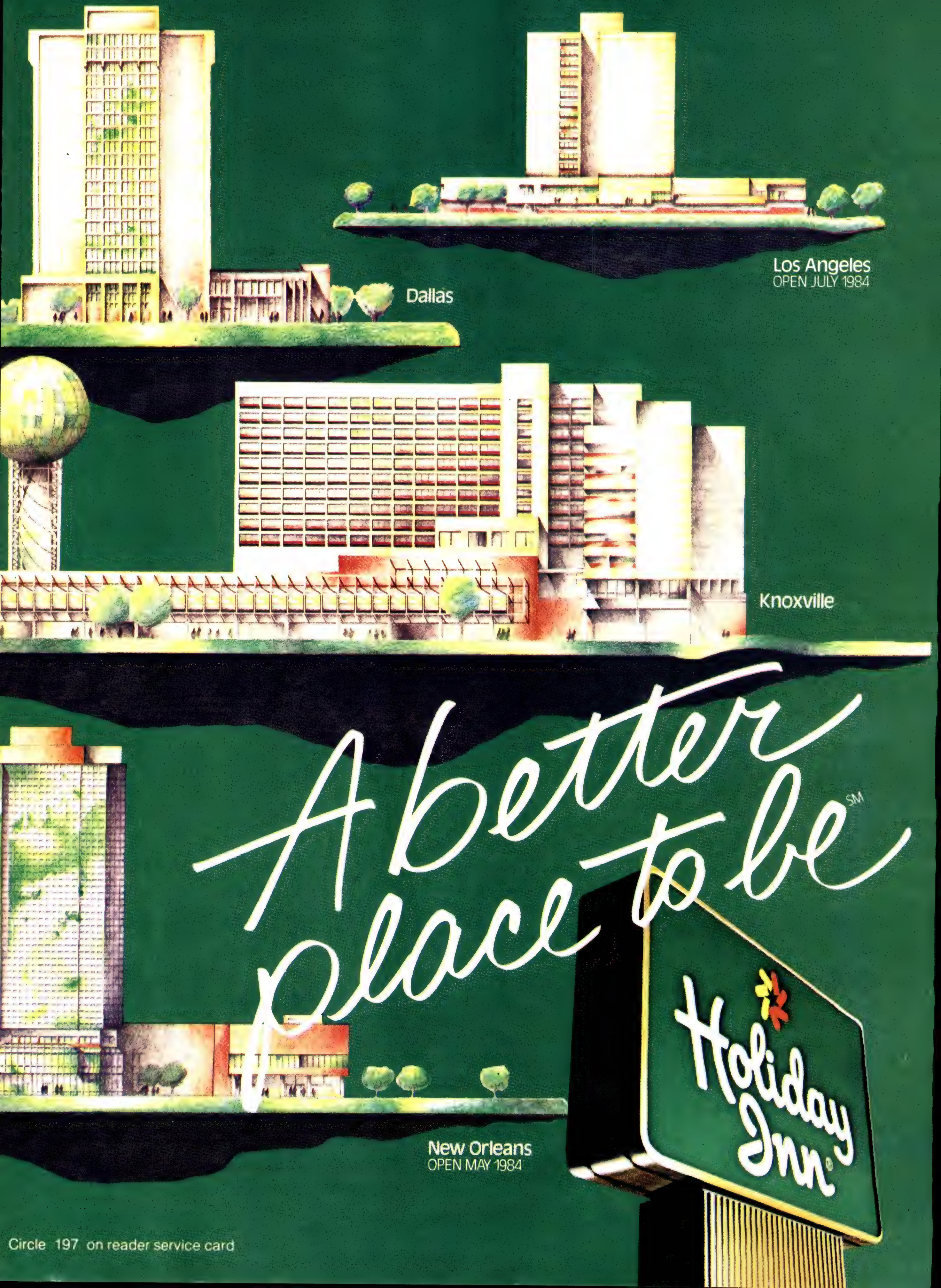

Circle 197 on reader service card

Semiconductors

40-pin PAL has 1,500 gates, runs at 16 MHz

The first of a new series of programmable-array-logic chips called MegaPAL, the 40-pin PAL32R16 has the equivalent of more than 1,500 gates, approximately four times as many as existing fuse-programmable logic devices. The company claims that the MegaPAL array can easily handle complex logic applications that previously required costly, time-consuming multichip or gate-array solutions.

Besides increased gate count, the PAL32R16 features product-term sharing, programmable bypass, and an output polarity option for more versatile programmability. Preload and automatic test-vector-generation capabilities ensure complete testability. With product-term sharing, two outputs can share 16 product terms, giving designers enough flexibility to deal with higher product-term needs.

Programmable bypass makes it possible to bypass output registers in banks of eight, leaving outputs for combinatorial logic. The chip's output polarity enables any output to be programmed to true or complement polarity. And preload testability gives users the ability to initialize all registers to any desired state.

To help users design with the MegaPAL, the company has released an assembly-language software program called PALASM 2, which makes fully automated test-vector generation possible, eliminating the typical bottleneck in the writing of test programs.

Powered by a single 5-V power supply, the PAL32R16 can operate at frequencies of 16 MHz or higher. The PAL comes in either a 40-pin dual in-line package or a 44-pin ceramic chip-carrier. Available from stock, the part sells for $53.94 each in lots of 100.

Monolithic Memories Inc., 2175 Mission College Blvd., Santa Clara, Calif. 95050. Phone (408) 970-9700 [Circle reader service number 401]

C-MOS 16-by-16 multiplier sells for $69 in small quantities

A complementary-MOS 16-by-16 multiplier, said to use one twentieth as much power as bipolar devices do, is now available from stock for $69 each in lots of 1 to 10 pieces. Designated the MPY-16IMI, the parallel 2's complement unsigned-magnitude or mixed-mode multiplier is pin-for-pin compatible with TRW's bipolar industry standard MPY-16HJ. The MPY-16IMI has a typical clocked multiply time of no more than 170 ns. Moreover, faster versions with multiply times in the bipolar league

TWA's 3 PAIR BEATS PAN A

are available as well.

The multiplier operates with a power consumption of less than 150 mW (at 5 V), compared with 3 W for comparable bipolar devices. Besides 64-pin dual in-line and flat packages, the part comes in leaded and leadless chip-carriers, as well as in pin-grid arrays.

International Microcircuits Inc., 3350 Scott Blvd., Building 37, Santa Clara, Calif. 95051. Phone (408) 727-2280 [Circle 404]

Standard-cell C-MOS process provides 5,000 usable gates

Called PaCMOS II, a new family of bulk complementary-MOS silicon-gate standard cells for semicustom-logic designs uses 3-μm geometries—lower feature sizes than the earlier PaCMOS has. The standard-cell family offers a high-speed cost-effective solution to designs with up to 5,000 usable gates.

Performance specifications include typical gate delays of 2 to 3 ns and operation over a frequency range of 10 to 40 MHz, depending on the application. Often 30% to 50% less expensive than their gate-array counterparts, plastic packaged PaCMOS II devices cost less than 1¢ a gate.

The PaCMOS II standard-cell library is supported on the Daisy Logician engineering work station for schematic capture. It is also accessible directly through RCA's VAX computer system or Tymnet for logic simulation using RCA's Mimic logic simulator.

RCA, Solid State Division, Rte. 202, Somerville, N. J. 08876. Phone (201) 685-6223

Voltage inverter is made with linear-circuit C-MOS process

A switched-capacitor voltage inverter that consumes little power and requires fewer external components than comparable devices, the LTC 1044 is the first component made with Linear Technology Corp.'s proprietary 20-V LTCMOS silicon-gate complementary-MOS process, which was tailored for linear integrated circuits. LTCMOS reduces charge injection, increases accuracy, and raises threshold stability and speeds above those possible with older, metal-gate processes.

Combined with LTCMOS, the LTC 1044's design produces a component that is less likely to latch up in operation and operates at up to 9 V with no external diodes over its operating temperature range.

In lots of 100, the price of the LTC 1044 ranges from $1.95 for the industrial-grade version (–40° to +85°C) in 8-pin plastic packages to $8.50 for the military-grade part. They are available now for immediate delivery.

Linear Technology Corp., 1630 McCarthy Blvd., Milpitas, Calif. 95035. Phone (408) 942-0810 [Circle 402]

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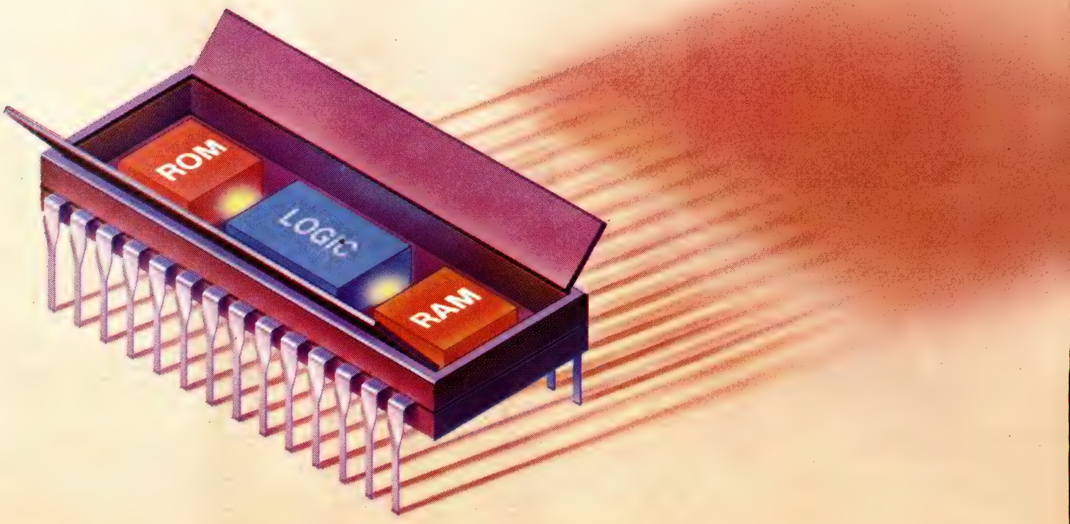

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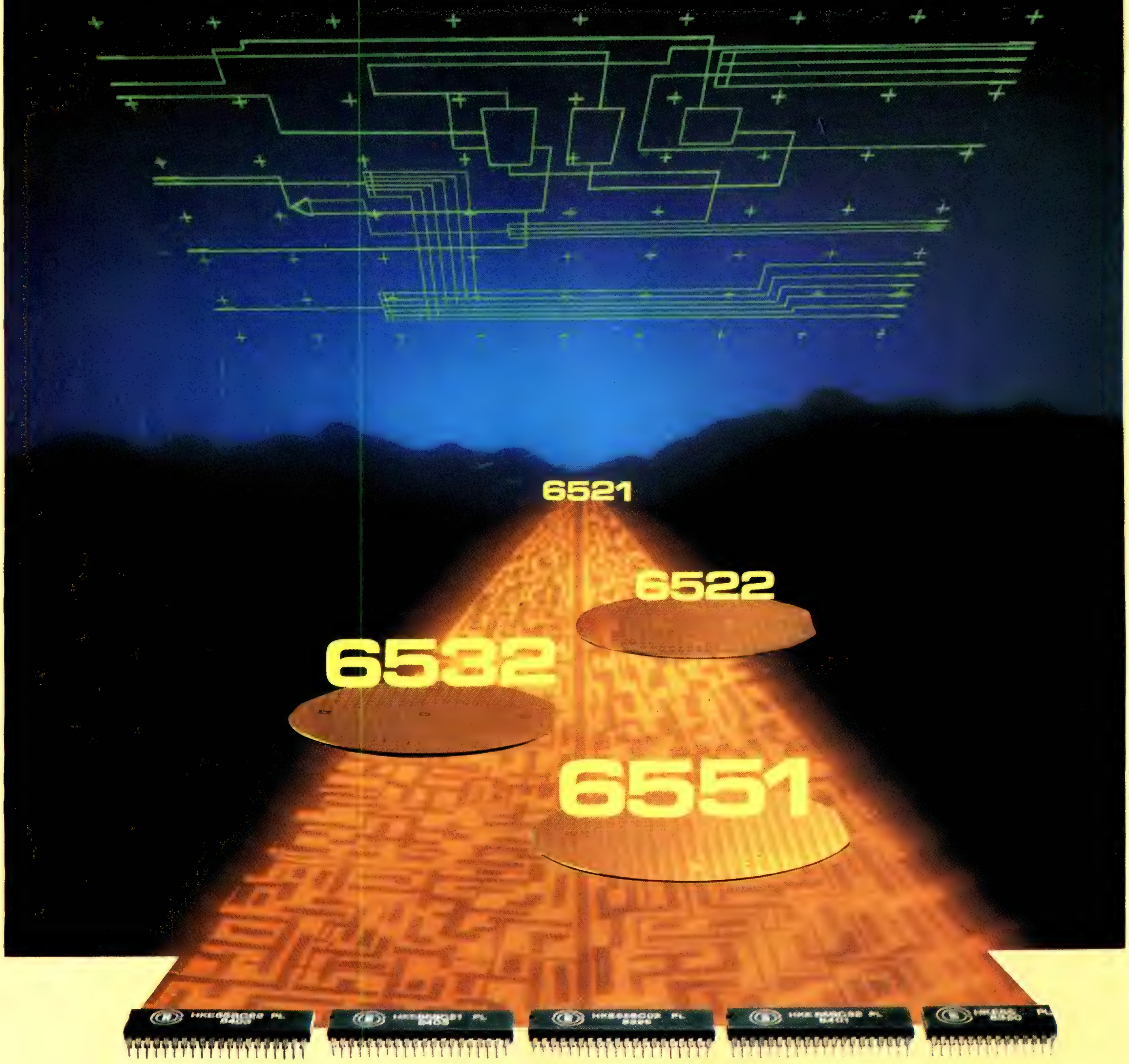

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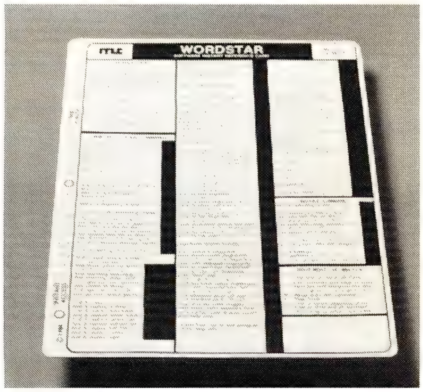
New literature

WordStar on a card. Users of WordStar can find control commands and other kinds of information easily on a low-cost plastic card. Half as expensive as keyboard overlays, the 8½-by-11-in. Micro Chart #9 has three times as much information. The card includes normal commands, dot commands, and commands for reforming paragraphs, moving text and columns, invisible returns, print control, and place markers, among other things. Such undocumented commands as ASCII-to-decimal conversion are also included. Micro Chart #9 costs $5.95 plus $1 for postage and can be ordered from Micro Logic Corp., P. O. Box 174, 100 Second St., Hackensack, N. J. 07602, (201) 342-6518. [Circle reader service number 421]

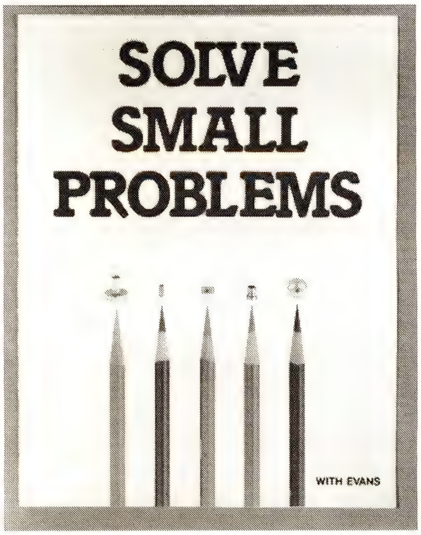


Converters and processors. A six-page application note discusses techniques for interfacing analog-to-digital converters with microprocessors for different a-d conversion rates. Titled "Simplify the Microprocessor Interface to Your 12-bit A/D Converter," the note points out that the key factor in simplifying the interface is to recognize the input/output category that is most appropriate for the a-d converter. Free copies of the note can be had by calling (516) 567-5600 or by writing to ILC Data Device Corp., 105 Wilbur Place, Bohemia, N. Y. 11716. [Circle 422]

Sensors. The "Pressure Transducer Handbook" contains information on how sensors are now used in manufacturing, energy management, avionics, medical diagnostics, and agrionics. Written for nonexpert end users, the book provides product information and describes applications. Complete proven circuit designs are presented as well. For free copies, call (408) 744-1500 or write to Sensym Inc., 1225 Reamwood Ave., Sunnyvale, Calif. 94086. [Circle 423]

Microcomputer explosion. The market for microminicomputers—microcomputers with minicomputer-like performance—will grow at an 86% rate, to $12 billion, by 1987. So found "Managing the Microminicomputer Explosion," an Electronic Trend Publications report, which predicts that the growth will come at the expense of minicomputers. The report also says that the minicomputer segment will shrink from 60% of the $10.9 billion small-computer market in 1983 to 18% of a $25 billion market in 1987. The $985 report has a 1978–82 market history and a 1983–87 forecast of microminicomputer markets in the U. S., Europe, and the Far East. To order, call (408) 996-7416 or write to Electronic Trend Publications, 10080 N. Wolfe Rd., Suite 372, Cupertino, Calif. 95014. [Circle 424]

Small change. A brochure titled "Solve Small Problems" shows examples of Evans Findings Co.'s capabilities for mass-producing small drawn-metal parts. The brochure offers five ideas for cutting manufacturing costs and a quote-request checklist. For a free copy, write to Evans Findings Co., 55 Johnson St., Providence, R. I. 02905. [Circle 425]



Strain gauge primer. Omega Inc.'s Temperature Measurement Handbook is a reference source that contains complete technical and application guides for all pressure or strain measurement or control applications. The strain-gauge-primer section is a minihandbook in itself. Also in the 200-page catalog are details on complete instrumentation for pressure measurement and control. For a copy, call (203) 359-1660 or write to Omega Engineering Inc., 1 Omega Dr., P. O. Box 4047, Stamford, Conn. 06907. [Circle 429]

Resistor stability. Electro-Science Laboratories' quarterly newsletter, Material Matters, features a report on improving resistor stability through conditioning. The report describes the effects of applying six types of conditioning to resistors and subjecting them to a range of tests. The latest issue also continues a series on choosing solder pastes for various applications. To be placed on the mailing list for this free newsletter, published quarterly by Electro-Science Laboratories, get in touch with the company at (609) 663-7777 or 2211 Sherman Ave., P. O. Box 596, Pennsauken, N. J. 08110. [Circle 426]

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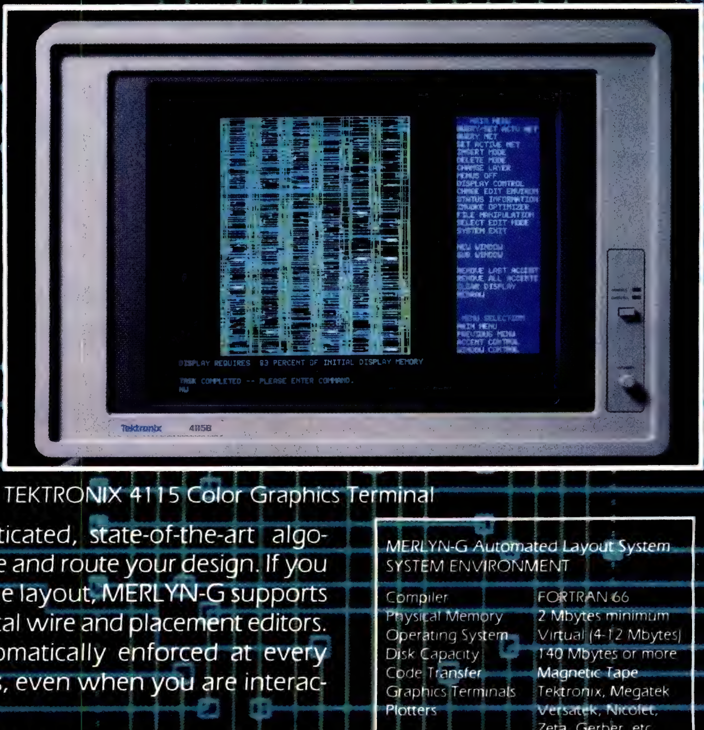

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The 1984 USENIX Conference and Vendor Exhibition, sponsored by the Usenix Association, is designed to promote the exchange of technical information and ideas among the Unix Community.

The Technical Conference will be held at the Hotel Utah, June 12th through 15th, 1984. A series of tutorial sessions is offered which will provide in-depth treatment of topics relevant to many users of Unix systems. The technical sessions demonstrate the breadth and depth of the research and development work being done within the Unix Community.

The vendor exhibition will be held at the Salt Palace Center, June 12 through 14th, 1984. The exhibition will bring together many major suppliers on Unix-related products showing the lastest technological achievements. Products exhibited will range from mainframes to micros, systems, peripherals and software.

1984 SUMMER USENIX CONFERENCE AND EXHIBITION

Conference: June 12th through 15th, 1984 at the Hotel Utah.

Exhibits: June 12th through 14th, 1984 at the Salt Palace, Salt Lake City, Utah.

For exhibit information, call (303) 696-6100; For conference information, call (213) 592-1381.

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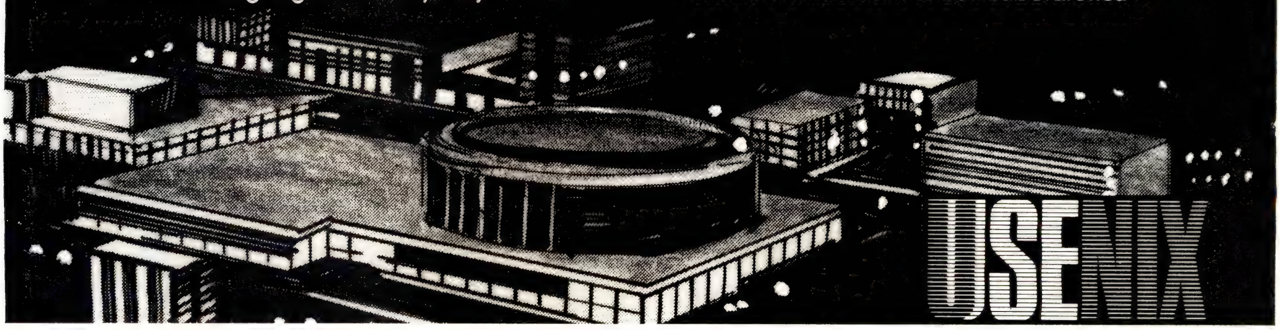

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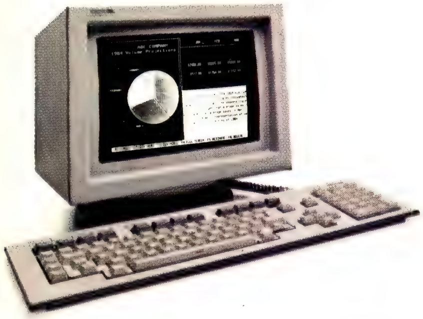

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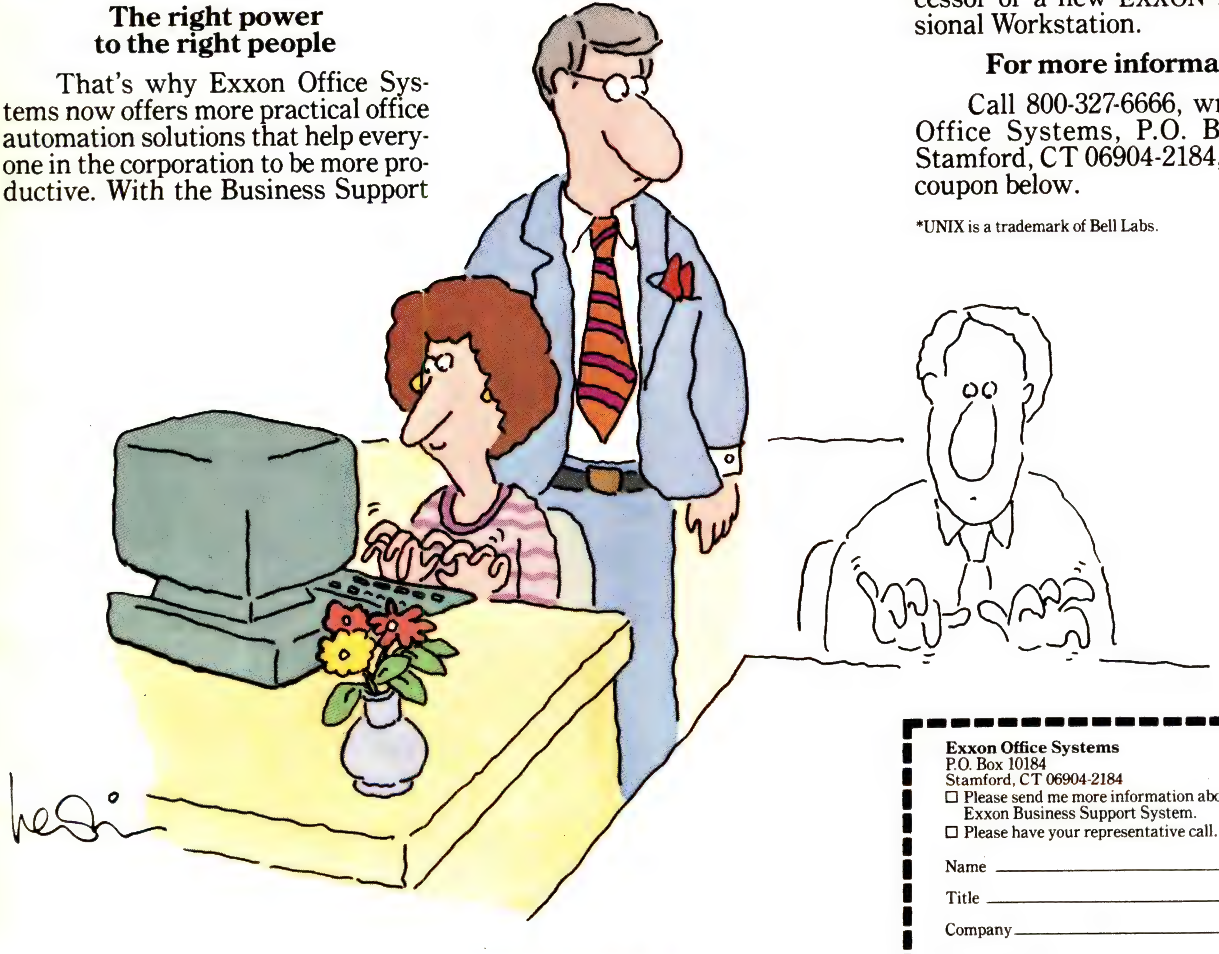

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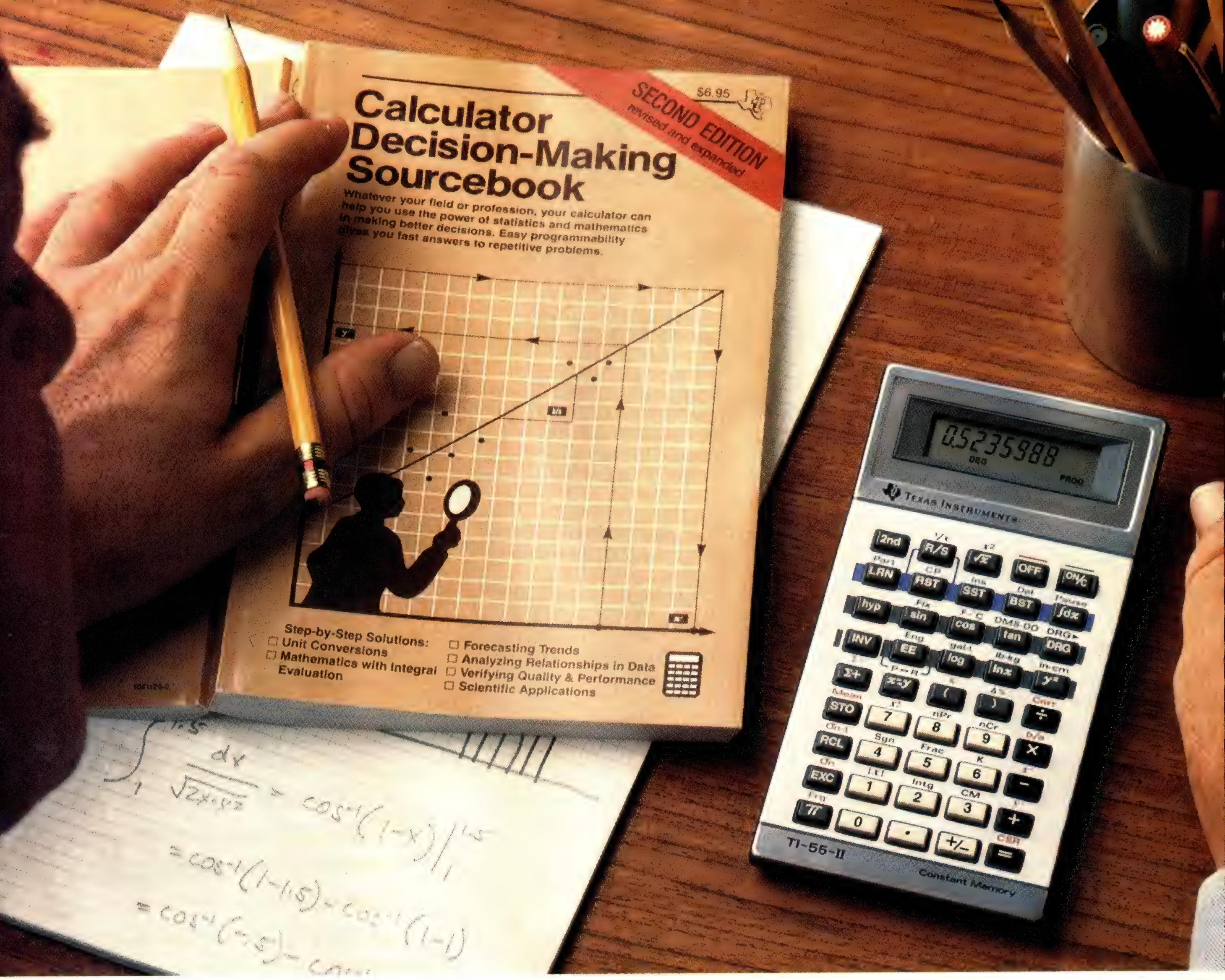
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Products newsletter

Protocol converter provides help messages

Realizing that most board-level protocol converters require frequent reference to a manual, Avatar Technologies Inc. will be unveiling at next week's Comdex show in Atlanta a converter with help screens as a standard feature. The PA100, priced at $895, **will allow International Business Machine Corp.'s Personal Computers to emulate various IBM 3278/79 terminals.** The easy-to-call help screens explain the equivalent 3278 keystrokes for the PC user. Another protocol converter that sells for $1,095 has dial-up disconnecting and multilevel password security, as well as the help screens. The PA1000E allows any Personal Computer or ASCII terminal to access either IBM mainframe computers or ASCII hosts either locally or remotely.

256-K ROM bows with low-power mode

NCR Corp.'s Microelectronics division, Miamisburg, Ohio, is offering samples of a 256-K read-only-memory that features a standby power-down mode. With power dissipation at 15 mA in standby mode (120 mA when active), **the chip should prove attractive for applications such as portable computers,** NCR says. Access times of 250 ns improve on the present NCR 256-K ROMs that offer 300-ns access times and current draws of 150 mA. The NCR 23256S comes in a Joint Electron Device Engineering Council 28-pin package, while a version known as the NCR 23257S will conform to an alternate 28-pin pinout supported by Motorola Inc. and Mostek Corp. The ROMs will be priced at $11.48 each in 10,000-piece orders and will be available in production quantities in six weeks.

Packaging technique boosts current rating of thyristors to 650 A

An aluminum casing that allows for better cooling and encapsulating larger semiconductor elements enables Westinghouse Electric Corp. to improve the current ratings in its thyristor-module product line from 90 A root-mean-square to 650 A rms. The Pow-R-Brik line from the firm's semiconductor division in Youngwood, Pa., combines the aluminum packaging with wider-diameter silicon elements to achieve this improvement. **Chip diameters range from 33 to 38 and 50 mm, compared with the 16 and 23 mm that are the industry's standard.** The higher current rating makes the thyristors useful building blocks for 440- through 600-V ac soft-start power controllers and dc drives, says Westinghouse. With a case-temperature rating of 85° and operating at 650 A and 1,200 V, the modules are priced at $274 each in 50-piece quantities; the lowest-rated Pow-R-Brik, rated at 380 A, costs $245 each in similar quantities.

Fiber-optic coupler claims a stable ratio

A single-mode fiber-optic coupler said to maintain a constant coupling ratio is now available from Gould's Defense Electronics division at half the price of competing products, the company says. That saving derives from **a proprietary fused-coupler manufacturing process for which Gould is awaiting a patent.** In addition to lower cost, the product's main advantage is that the coupling ratio is thermally stable within 0.110%/°C and insensitive to input-light-polarization deviations to within 0.5%, says the Glen Burnie, Md. division. High-performance couplers, selling for $1,000 each, guarantee an excess signal loss of less than 0.5 dB; the economy version for $500 guarantees losses of less than 2 dB.

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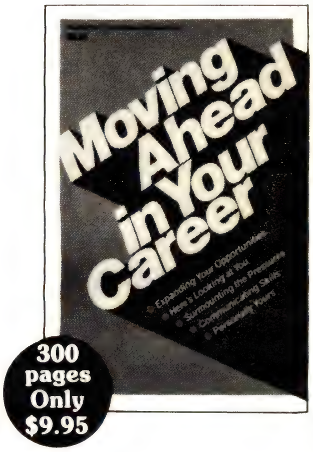
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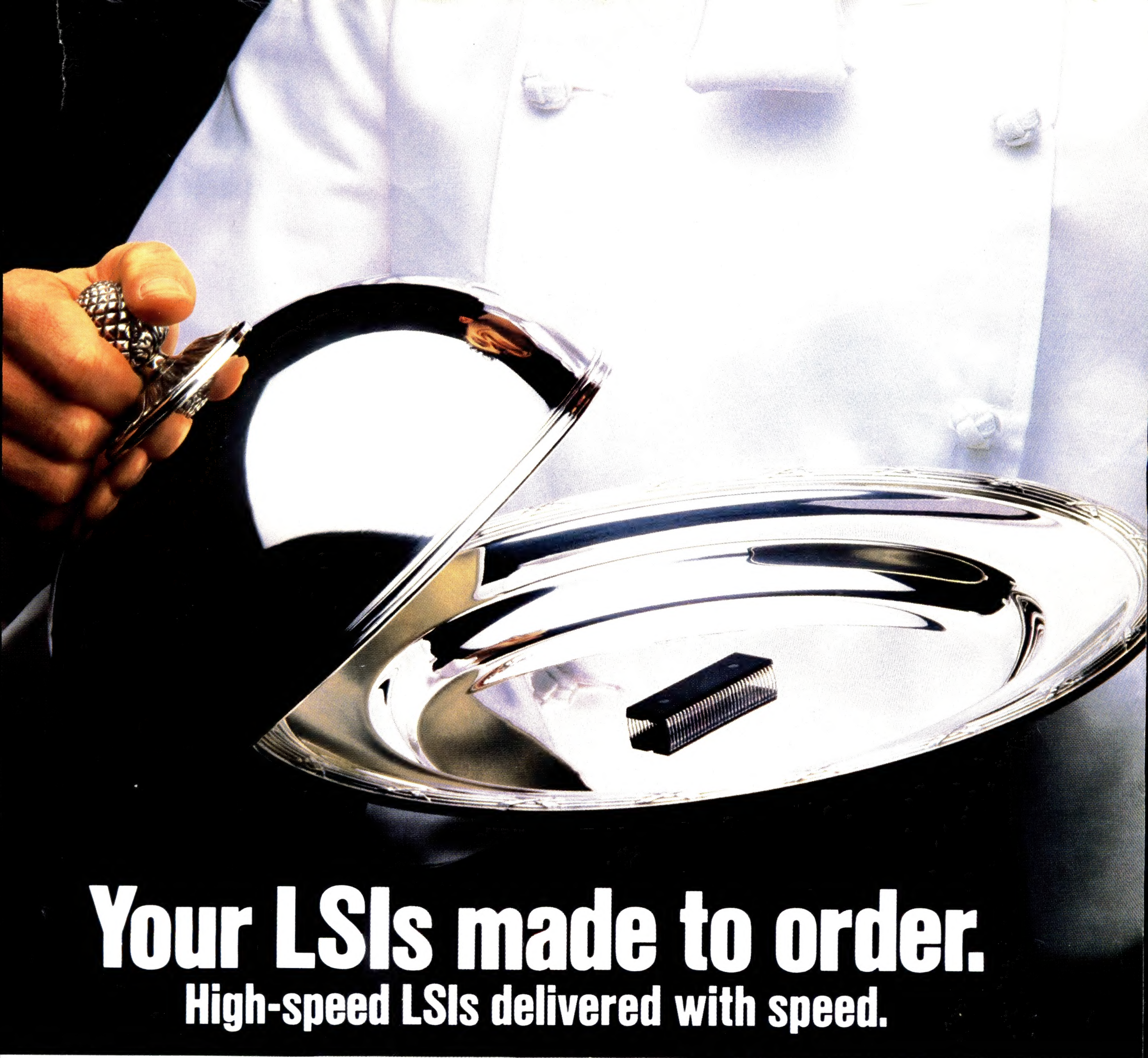

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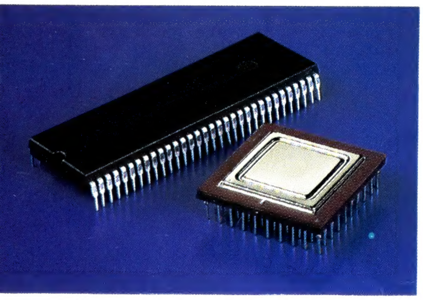

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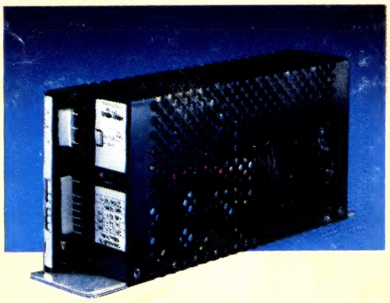

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